

**STANDARD SPECIFICATIONS
FOR
DESIGN AND CONSTRUCTION**

**ADOPTED BY
KANE COUNTY COMMISSIONERS
NORMAN CARROLL, CHAIRMAN
JOE C. JUDD
STEPHEN R. CROSBY**

DATE - 9/22/97

**PREPARED BY: BUSH AND GUDGELL, INC.
205 EAST TABERNACLE
ST. GEORGE, UTAH 84770**

Development: Any project involving the platting or improvement of real property for public use including, but not limited to streets, utilities and drainage-ways. Subdivisions of every type shall be considered to be for public use even though streets and facilities may be limited to private use.

PROCEDURES AND RESPONSIBILITIES:

A. Public Improvements:

All developments containing public streets must provide the minimum inspection and testing as set forth herein to the County Engineering Department before acceptance of any public improvement.

B. Private Improvements:

All subdivisions, planned unit developments and other developments containing private streets shall comply with the County Standards and with these minimum requirements. Such developments shall be required to provide the minimum inspection and testing as set forth herein and a certification of compliance (see standard for, "Private Development Improvement Certification" attached herewith) for submission to the appropriate homeowners association prior to their acceptance of the development. Failure to provide the required certification may result in prosecution for non-compliance with the County subdivision and development ordinances.

C. Inspection and Testing Requirements:

The inspection and testing requirements set forth below are the minimum required for approval of developments. The County Engineer or the testing firm may require additional inspections, directives, tests, testing frequencies, or alternate tests as may be reasonable necessary to determine the soundness of related improvements.

1. Earthwork:

Soil Classification - One per material source.

Soil Proctor - One determination for each significant change in soil type as necessary to provide required compaction testing.

*Earth fill moisture/
density determination* - One test per 500 cubic yards of fill placed in an embankment.

*Sub-grade moisture/
density determination* - One test per 750 square yards of surface area.

Moisture density determinations shall be made in accordance

with Section 3 of the County Standards. Proctors for all earthwork compaction shall be determined using ASTM D-1557 modified proctor method.

*Trench backfill moisture/
density determination -*

The following tests are required for structural backfill as set forth in Section 3 of the County Standards for every 200 lineal feet of trench or portion thereof:

One test at pipe zone.

One test per 2 feet of depth measured from the bottom of the Sub-grade to the top of the pipe zone. Tests shall be evenly spaced vertically through the trench with one test at top of trench (bottom of Sub-grade).

Additional testing may be required by the County Engineer or soils testing lab to verify compaction.

Moisture/density determinations shall be made in accordance with Section 3 of the County Standards. Proctors for all trench backfill compaction shall be determined using ASTM D-1557 modified proctor method.

2. Base Course Gravel:

Gradation Tests -

One test per 15,000 square feet of roadway surface area or fraction thereof.

One test per 500 lineal feet of curb and gutter (each side) or fraction thereof.

One test per 1,350 square feet of a combination of sidewalk and driveway or fraction thereof.

Moisture/Density Tests -

One test per 7,000 square feet of roadway surface area or fraction thereof. Moisture content shall be at optimum plus or minus 2% for test to pass and shall be maintained until prime coat is applied.

Thickness -

One random - boring or test hole per 5,000 square feet of surface area or fraction thereof to verify required thickness. If sufficient inspection has been made by a County inspector to verify required thickness, the County Engineer may waive thickness testing for base course gravel placed in public

roadway construction.

No single measured thickness shall be less than the required design thickness.

3. Bituminous Surface Course:

Material Certification - Each project shall submit independent written certification through the material supplier that surface course materials comply with County standard specifications.

Certification for a material source previously approved for the current construction season will be acceptable, provided sources of the individual components of the combined surface course mix have not changed.

Extraction - Gradation Test - One test per 500 tons of material placed or one per day whichever is less.

Density Tests - One test per 7,000 square feet of surface area or fraction thereof.

Thickness Tests - One core sample from each section of approximately 9,000 square feet or fraction thereof. At the discretion of the County Engineer, thickness testing may be waived for material placed in public roadway construction if sufficient inspection has been made by a County inspector to verify required thickness.

4. Concrete:

Mix Design Certification - One per job.

Compressive Strength Tests - One set of (3) cylinders for each 50 cubic yards of concrete placed.

Air Entrainment - Tested at beginning of placement until two consecutive tests pass. Others shall be taken as required.

Slump Tests - Tested at beginning of placement until two consecutive tests pass. Others shall be taken as required.

5. Drainage Systems:

- Materials -* Materials suppliers shall submit certification of compliance for all materials used. Materials must be appropriately marked. Certifications and markings shall be submitted as required in current County standard specifications.
- Grades -* Invert elevations of each box inlet and outlet and distance measurements between boxes shall be verified by a surveying instrument prior to pouring of the box floor.
- Visual -* All drainage systems shall be visually inspected for defectiveness, displacement, workmanship, alignment, cleanliness and general compliance.

6. Sewer Line:

- Materials -* Materials suppliers shall submit certification of compliance for all materials used. Materials must be appropriately marked. Certifications and markings shall be submitted as required in current County standard specifications.
- Grades -* On main lines invert elevations of each inlet/outlet of manholes and distance measurements between manholes shall be verified with a surveying instrument prior to pouring of manhole floor. For service laterals grades shall be verified by a carpenter's level or surveying instruments.
- Compaction -* All sewer trench compaction testing shall be completed and approved prior to performing air and deflection tests.
- Air Test -* All mains, laterals and manholes shall be air tested in accordance with current County standard specifications.
- Deflection Test -* Mandrell testing shall be performed on all mains as directed by County inspector and in accordance with current County standard specifications.
- Cleaning -* Main lines shall be cleaned by flushing a "Wayne" ball of corresponding diameter through each line.
- Visual -* All sewer systems shall be visually inspected for defectiveness, displacement, workmanship, alignment and general compliance.

7. Water Line:

Test results submitted for pressure and operation testing in accordance with current County requirements.

8. Other Utilities:

All utility installations, i.e., gas, power, phone, cable T.V., etc., shall conform to the applicable test requirements noted above for earthwork, compaction, base course, bituminous surface course, concrete and other materials.

In addition to the foregoing minimum testing, certificates of compliance may be required from materials suppliers for other materials not specifically covered.

All subdivisions and planned unit development projects shall also submit a final soils engineering and engineering geology report as per Section 7015 "Completion of Work" of the Uniform Building Code, 1992 Edition.

PRIVATE DEVELOPMENT

IMPROVEMENT CERTIFICATION

PROJECT: _____ JOB ADDRESS: _____

OWNER: _____ DEVELOPER: _____

The undersigned professional engineer has provided professional inspection, testing and supervision and states that the work completed on the above private development with respect to roads, utilities, and related private improvements meets or exceeds the standards of "Kane County Standard Specifications for Design and Construction" and other requirements for County approval.

A report containing a description of the work, recommendations and testing results is attached herewith.

Remarks: _____

Civil Engineer: _____

Date: _____

Professional Stamp:

Expiration Date:

FORWARD

The Kane County Engineering and Surveying Department have prepared the following edition of the

KANE COUNTY STANDARD SPECIFICATIONS FOR DESIGN AND CONSTRUCTION

These standards and specifications shall be used for all work located within public streets, rights of ways, and easements within Kane County.

Nothing in these specifications shall be construed to prohibit the construction of higher type improvements, as approved by the County Engineer.

These standards and specifications meet with full approval of the County Engineer.

Any differences or conflicts between these Standards and Specifications and the Kane County Subdivision Ordinances, the more restrictive shall apply.

These standards and specifications were approved by the Kane County Commission by Resolution/Ordinance dated _____.

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SECTION 1 GENERAL IMPROVEMENT REQUIREMENTS

1.1 GENERAL: This section defines the general requirements for public improvements within Kane County.

The improvements shall include all improvements of a public need, including, but not limited to streets, water, sewer, power and drainage. Required improvements shall extend from the nearest acceptable point of existing improvements. Layout must provide for future extension to adjacent properties and shall be compatible with appropriate County general or master plans. All water lines shall be installed to the boundary lines of the subdivision.

1.2 DEFINITIONS:

- (a) Contractor shall refer to the person or persons actually performing the construction work.
- (b) Customer shall refer to any individual requiring utility services (power, water or sewer).
- (c) Developer shall refer to the contractor, property owner or his agent as applicable.
- (d) County Engineer or Surveyor shall refer to the Kane County Engineer or Surveyor or his authorized representative.
- (e) Owner shall refer to sub-dividers, developers, or others responsible for constructing improvements or developments on property within Kane County. In the case of work bid out by the County as contract work, "owner" shall refer to the contractor doing the work.
- (f) Sewer Lateral shall refer to any sanitary sewer pipe which runs from the outside of any building to the sewer main line.
- (g) Sewer Main shall refer to any sanitary sewer line which is eight inches in diameter.
- (h) Sewer Sub-Main shall refer to any sanitary sewer line which is six inches in diameter and less than 200 feet in length and having no more than 15 sewer laterals (individual units) connected.
- (i) Sewer Trunk Line shall refer to any sanitary sewer line which is greater than eight inches in diameter and having two or more sewer mains as it's tributaries.
- (j) Sewer Outfall Line shall refer to any sanitary sewer line which carries major sectors of the community or region having trunk lines as it's tributaries.

1.3 CONSTRUCTION DRAWINGS: Complete and detailed construction plans and drawings of improvements shall be submitted to the County Engineer prior to commencing construction. No construction shall be started until plans have been checked and approved by the County Engineer.

The following instructions are for the purpose of standardizing the preparation of drawings to obtain uniformity in appearance, clarity, size and style:

(1) Four sets of construction plans shall be submitted to the county with three sets to be retained by the County Engineer and one set returned to the Owner/Contractor with the approval mark of the appropriate County officials clearly stamped on the plans. This approved set shall be kept available at the construction site at all times during the construction of the project.

(2) The plans and designs shall meet the standards defined in the Specifications and Drawings hereinafter outlined.

(3) All drawings and/or prints shall be clear and legible and conform to good engineering and professional drafting room practice. Size of drawings shall be 24" by 36".

1.3(a) GENERAL: The following shall be included on the drawings:

(1) North arrow (plan).

(2) Scale and elevations referenced to U.S.G.S. datum.

(3) Stationing and elevations for profiles.

(4) Title block, located on the right side of the sheet to include:

(a) Project title;

(b) Type of project;

(c) Professional stamp.

1.3(b) CURB AND GUTTER, DRAINAGE, SIDEWALKS AND STREETS: The drawings for curb and gutter, drainage, sidewalks and streets shall show:

(1) Both plan view and centerline profiles for each street.

(2) At curb returns, elevations at all P.C.s, P.I.s and P.T.s.

- (3) Stationing and all curve data.
- (4) Details of drainage system showing flow directions and types of drainage structures.
- (5) Bench mark locations and elevations (U.S.G.S. datum must be used).
- (6) Type of curb and gutter and distance from back of curb, to the property line.
- (7) Gradient (center line of roads, top back of curbs and flow lines of drainage pipes).
- (8) Location of existing and proposed permanent survey monuments on the approved plans and drawings.

1.3(c) SEWER: Sewer drawings shall show:

- (1) Location, size, and grade of mains (existing and proposed).
- (2) Manhole size, location and flow line elevations.
- (3) Type of pipe (in accordance with County specifications).
- (4) Bench mark locations and elevations (U.S.G.S. datum must be used).

1.3(d) CULINARY WATER: Culinary water drawings shall show:

- (1) Size and location of all existing and proposed water mains, valves and hydrants.
- (2) Type of pipe (only pipe types approved by Kane County may be used).
- (3) Minimum cover (36 inches to top of pipe).

1.3(e) POWER: Power drawings shall show:

- (1) Point of interconnect (to be determined by Power Superintendent before plans are prepared).
- (2) Location of existing and proposed transformers, service boxes, street lights, etc.
- (3) Primary, secondary, and service lines and phasing details.
- (4) Topography and proposed grading.

- (5) Sizes, capacities and characteristics of all components (e.g., wire, transformers, etc.).

1.3 (f) DETAIL SHEETS: Each set of plans shall be accompanied by a separate sheet of details for structures which will be constructed. Detail sheets shall include the following information:

- (1) Drawing size: 24" by 36".
- (2) Scale of each detail.
- (3) Title block on the right side of the sheet (same format on all sheets).
- (4) Name of the development.
- (5) All details must be completely dimensioned and described.

1.4 INSPECTION AND TESTING: All construction work involving the installation of improvements in Kane County shall be subject to County inspection and testing including, but not limited to the following:

- (1) Grading and embankment.
- (2) Forming and pouring of concrete for curb and gutter, sidewalks and other structures.
- (3) Laying of sewer pipe, drainage pipe, water pipe, valves, hydrants and testing.
- (4) Installation of power systems.
- (5) Street sub-grade and gravel base.
- (6) Street paving.
- (7) Cleanup work.

1.4(a) REQUESTS FOR INSPECTION: Requests for inspections shall be made to the County Engineer or Inspector by the person responsible for the construction. Notice shall be given 24 hours in advance of the starting of work. Any work to be backfilled shall not be backfilled prior to inspection.

1.4(b) CONSTRUCTION COMPLETION INSPECTION: A final inspection shall be made by the County Engineer or his representative upon receipt of a written request by the owner after all construction work is completed. Any faulty or defective work shall be corrected by the persons responsible for the work within a period of thirty (30) days from the date of the County Engineer's

inspection report defining the faulty or defective work.

1.4(c) QUALITY CONTROL TESTING: Material testing shall be conducted by an independent laboratory approved by the County Engineer at the owner's expense. All testing shall comply with current ASTM, AASHTO, AWWA or Public Drinking Water Regulation standards and shall meet the minimum testing requirements as outlined in the specifications. The cost of any and all re-testing required to bring materials into specification shall be borne by the owner or contractor.

1.5 GUARANTEE OF WORK: The owner shall warrant and guarantee that the improvements provided for hereunder, and every part thereof, will remain in good condition for a period of one year after the date of the "Construction Completion Inspection Report" by the County Engineer. The owner shall agree to make all repairs to and maintain the improvements and every part thereof in good condition during the specified time at no cost to the County.

The determination for the necessity of repairs and maintenance of the work shall rest with the County Engineer. His decision upon the matter shall be final and binding upon the owner. The guarantee hereby stipulated shall extend to and include, but shall not be limited to the entire road base, power system, all pipes, joints, valves, backfill and compaction as well as the working surface, curbs, gutters, sidewalks, and other accessories that shall be constructed by the owner. Whenever, in the judgment of the County Engineer, said work shall be in need of repairs, maintenance, or rebuilding, he shall cause a written notice to be served the owner and thereupon the owner shall undertake and complete such repairs, maintenance or rebuilding. If the owner fails to do so within thirty days from the date of the service of such notice, the County Engineer shall have such repairs made, and the cost of such repairs shall be paid by the owner together with 25% of the cost of the repairs in addition thereto, for stipulated damages for such failure on the part of the sub-divider to make the repairs. Any omission on the part of the Engineer to condemn defective work or material at the time of construction shall not be deemed an acceptance. The contractor will be required to correct defective work or material at any time before final acceptance and within one year thereafter.

1.6 BARRICADES AND WARNING SIGNS: The contractor shall provide, erect, and maintain all necessary barricades, suitable and sufficient lights, danger signals, signs, and other traffic control devices. He shall take all necessary precautions to protect the work and to safeguard the public. Streets closed to traffic shall be protected by effective barricades, and obstructions shall be illuminated during hours of darkness. Suitable warning signs shall be provided to control and direct traffic properly. All traffic control operations and signing shall be performed in accordance with the instructions outlined in the "Manual on Uniform Traffic Control Devices", latest edition.

1.7 SURVEY MONUMENTS: Standard County survey control monuments (as shown in the appendix drawings of these specifications) shall be installed in all streets to be dedicated for public use. All survey control monuments shall be installed in strategic locations (as determined by the County Surveyor) so as to insure adequate survey control required for subsequent resurvey in the area.

SECTION 2

DESIGN STANDARDS

2.1 GENERAL: This section defines design requirements for public improvements within Kane County. It is not the intent of these specifications to restrict professional judgment, but rather to serve as a guide and to establish consistency in design.

2.2 STREET DESIGN: All streets within the County shall be designed structurally to conform to Section 4, "Roadway Construction", of these specifications. Streets shall conform to County specifications for grades, center line curve radii, right of way, pavement, curb, gutter and sidewalk dimensions as shown in Table 2.1.

**TABLE 2.1
STREET DESIGN STANDARDS**

WIDTH (IN FEET)						CURB & GUTTER	
STREET TYPE	MAX. GRADE	MIN. C.L. RADIUS	RIGHT- -OF- WAY	PAVE- MENT	SIDE- WALK (1)(3)	TYPE (2)	MIN. RAD.
LOCAL	15	100	50	35	4	HB30-7	20
COLLECTOR	15	300	60	45	5	HB30-7	20
MAJOR COLLECTOR	12	400	66	50	5	HB30-7	25
ARTERIAL	10	500	80	65	5	HB30-7	35
MAJOR ARTERIAL	10	600	>80	>65	6	HB30-7	40

Notes for Table 2.1:

(1) In industrial and manufacturing areas road pavement may be widened 10 feet in lieu of

concrete sidewalks as approved by the County Engineer.

(2) Areas of high water flow may require larger curb and gutter capacity than shown.

(3) Sidewalk in areas of high pedestrian traffic shall require greater width as determined by the County Engineer.

Streets shall be designed to provide adequate stopping and sight distance, degree of curve, and super-elevation in accordance to standard engineering practice. Curve linear streets shall have a minimum center line radius of 300 feet for local, 500 feet for collector, and 800 feet for arterial streets. Street intersection center line off-sets shall be not less than 150 feet. Street intersections shall be as near to 90° as possible. Cul-de-sac streets shall not exceed 1600 feet in length, and the turn-around radius (at property line) shall be not less than fifty feet.

2.3 DRAINAGE SYSTEM DESIGN: All subdivisions in the County shall be designed to accommodate rainfall and underground spring run-off in systems separate and independent from the sanitary sewer system.

2.3 (a) SPRING CONTROL: Where in the determination of the County Engineer spring control is necessary, the owner shall provide an adequate pipe system to eliminate the nuisance of overland flow.

2.3 (b) FLOOD CONTROL: Prior to altering the natural terrain, developers shall consult with the County Engineer to determine the flood control measures necessary in their project area.

A flood control system shall be designed and approved as part of the construction plans. Flood water may be conveyed in pipes, major washes, designated floodway easements, or dedicated county streets. Where open ditches or canals exist within or adjoining a subdivision, the owner shall coordinate with the irrigation company to accommodate safety or flood control needs. Any canal use or modification will require irrigation company approval.

Design of flood control systems shall meet the following criteria:

(1) A flood of 100 year return frequency shall be conveyed within the limits of street right of way or easements when used for flood control purposes.

(2) All occupied buildings shall be constructed outside floodway limits and two feet above the 100 year flood stage.

(3) Where an underground pipe system is required, it shall be designed to carry a 10 year return frequency. Major hydraulic structures shall be designed to carry a 25 year return frequency.

(4) Streets may be inverted to carry floodwater only with sufficient justification and upon approval of the County Engineer.

(5) When designing flood systems, the Engineer shall give proper consideration to adjacent properties. The drainage basin upstream shall be assumed fully developed to conform with the current land use master plan. The impact of said run-off on down-stream properties shall also be considered in the design, including acquisition of easements or agreements where necessary.

2.4 SANITARY SEWER DESIGN:

2.4(a) DESIGN FLOWS: All sanitary sewers and appurtenances shall be designed to carry the design flows from all contiguous areas which may, within a reasonable period in the future, be tributary thereto.

Sanitary sewers shall be designed to carry the peak discharge as specified below; also, all sewers shall be designed to transport suspended material so as to preclude the deposition of any solids in the sewer line.

New sewer systems shall be designed on the basis of an average daily per capita flow of not less than 100 gallons per day. Sanitary sewer systems shall be designed to prohibit infiltration and inflow. To provide for peak loads sanitary sewers shall be designed to carry, when 2/3 full, not less than the following:

Laterals and sub mains	400 gallons/capita/day
Mains, trunks and outfalls	250 gallons/capita/day

All sewers shall be designed and constructed with hydraulic slopes sufficient to give mean velocities (when flowing 2/3 full) of not less than 2.0 feet per second based on Manning's formula, using a value for "n" of not less than 0.013. The following shall be the minimum slopes to be provided, unless approved otherwise by the County Engineer.

SEWER SIZE (inches)	MINIMUM SLOPE (ft/100 feet)
4	2.00
6	0.80
8	0.50
10	0.48
12	0.47
15	0.45
18	0.43
21	0.42
>24	0.40

Under special conditions, when justifiable reasons are given, slopes slightly less than those required for the two foot per second velocity when flowing 2/3 full may be permitted. Such decreased slopes will only be considered where the depth of flow will be 0.3 of the diameter or greater for the design average flows, and where computations of the depth of flow in such pipes at minimum, average and design. The Engineer must furnish computations for velocities and depth of flow for grades in excess of 10% and for extremely low flow situations.

2.4(b) MINIMUM SIZE AND DEPTH: No public sanitary sewer shall be less than eight inches in diameter, except terminal sewers on short cul-de-sacs or private developments which may be six inches in diameter, not to exceed 200 feet in length and limited to the equivalent of 15 residential units attached. Minimum size of house connections shall be four inches in diameter. Minimum size of restaurant connections shall be six inches in diameter. Only one residence, structure, or building shall be served by each lateral connected to the public main (See Uniform Plumbing Code, Chapter 4).

In general, sanitary sewers shall be designed of sufficient depth to permit sewer laterals from basements to connect. Exceptions may be granted in subdivisions or areas in which houses without basements are to be constructed. In such case a note to that effect shall be made on all plans presented for approval. In no case shall sanitary sewers be designed for a depth of cover less than 36 inches over the top of the sewer pipe. Where shallower depths are unavoidable, consideration may be given to the construction of a concrete-encased, or similarly protected, sewer, as circumstances

may direct. Proper allowance for loads on the sewer shall be made based on width and depth of the trench. All sewers shall be designed to prevent damage from super-imposed loads as well as trench loading conditions. Where necessary, special construction may be required.

2.4(c) ALIGNMENT: In general, all sanitary sewers shall be designed for uniform slope and alignment between manholes and shall be laid a distance of at least ten feet (horizontally) from any existing or proposed water main. In the event that a sewer main cannot be laid at least ten feet from an existing or proposed water main, then the County Engineer may authorize the implementation of the provisions of section 2.5(g)6 of these specifications.

All sewer laterals shall intersect the sewer main on the top third of the sewer main pipe as shown in the drawings in the Appendix.

2.4(d) SERVICE CONNECTIONS: Service connections to any public sanitary sewer shall be made only to a tee installed at the time of the sewer main installation or by a machine tap and approved saddle compatible with the main line sewer material in accordance with the drawings shown in the Appendix of these specifications and shall be a minimum of ten feet, measured horizontally, from any culinary water line or tapping. All connections and service lines must be water tight. All sewer clean-outs shall be made with a standard wye fitting.

All sewer laterals connected to public sewer mains shall conform to the following table:

TYPE OF UNIT OR RESIDENCE	MINIMUM SEWER LATERAL SIZE (Diameter)	MINIMUM SLOPE
Single-Family Residences	4 inches	2%
Townhomes	4 inches/unit	2%
Multi-Family Condominiums	6 inches	1%
Commercial Establishments	6 inches	1%
Mobile Homes	4 inches	2%
Apartments	See notes below	

NOTES:

- 1) Lateral size and slope shall be based on the number of fixture units in the apartment, in accordance with the Uniform Building Code.
- 2) Under no circumstances shall roof drains, foundation drains, storm drains or sub-drains

be connected to the sanitary sewer system.

2.4(e) MANHOLES: Manholes shall be installed at all changes in grade, size or at all intersections; and at distances no greater than 400 feet apart. All manholes shall be accessible to maintenance vehicles, and all sewer easements shall provide at least 12 feet of unobstructed width. Drop manholes shall be provided for a sewer line entering a manhole at an elevation of 18 inches or more above the manhole invert. Floor troughs shall be furnished for all sewers entering manholes, and shall be at least as deep as the full diameter of the sewer main in the manhole.

When a smaller sewer main joins a larger sewer main in a manhole, the pipe flow line elevations shall match.

All manholes shall conform to the detailed dimensions, construction details and materials as shown on the drawing entitled "Standard Manhole" as provided in the Appendix of these specifications. Manholes shall also conform to the conditions as detailed in Section 9.8(f) of these specifications.

Sewer manholes for all sewer mains of 18 inches or less in diameter shall be a minimum of four feet in inside diameter. For sewer mains larger than 18 inches in diameter or over 12 feet in depth, or where three or more eight inch or greater sewer lines converge, the manholes shall be not less than five feet in inside diameter.

2.5 CULINARY WATER DESIGN: All culinary water mains and appurtenances within the County shall be designed to provide for adequate future service for all contiguous areas which may, within a reasonable period in the future, be tributary thereto.

2.5(a) DESIGN FLOW PRESSURES: Water mains shall be designed to provide a minimum residual pressure of 20 psi under maximum day demand conditions including designed fire flow (as called out in Section 2.5g of these Specification). A minimum of 40 psi residual pressure must be maintained under normal peak hour conditions without fire flow.

2.5(b) PEAK INSTANTANEOUS FLOW: See Page 11A

2.5(c) MINIMUM SIZE AND DEPTH: The minimum depth of cover (to the top of the pipe) for water mains shall be three feet below the final grade of the street. Where final grades have not been established, mains shall be installed to a depth great enough to insure three feet of cover below future grade based on the best information available. The water mains shall be sized to deliver the peak instantaneous flow rate as determined in Section 2.5(b). The fire flow requirements and pressures shall be as outlined in Section 2.5(g) of Kane County Subdivision Ordinances. The minimum size water main serving any fire hydrant shall be six inches in diameter.

2.5(d) VALVES AND HYDRANTS: The water system shall be looped and valves shall generally be spaced such that a break in any one length of main will put no more than 1200 feet of main nor

more than two fire hydrants out-of service (whichever is less) while maintaining adequate minimum service in the remainder of the water system during repairs, except for major transmission lines, where longer spacing may be allowed. All distribution mains connecting to larger supply mains shall be valved at the connection. All fire hydrant runs shall also be valved.

Valves generally shall be located at street intersections in line with an extension of the property line.

2.5(e) PRESSURE REDUCING VALVES: The County recommends that in high water pressure zones in the County secondary pressure reducing devices shall be installed by the owner on all water connections to buildings. The locations of the high water pressure zones within the County can be located and identified upon request from the controlling water company.

2.5(f) FIRE HYDRANT SPACING AND LOCATION: See County Subdivision Ordinance.

2.5(g) FIRE FLOW REQUIREMENTS: See County Subdivision Ordinance.

2.5(h) MISCELLANEOUS WATER SYSTEM DESIGN CRITERIA:

(1) All public water mains shall be installed in an easement at least 12 feet in unobstructed width or in public rights of way with adequate access for maintenance vehicles.

(2) Dead-end mains shall be avoided wherever possible and if installed, shall not exceed 600 feet. Hydrants or line flush unit shall be located at the end of dead-end mains for flushing purposes as well as for fire protection. Blow-off valves, rather than fire hydrants, are not desirable except where warranted by special circumstances as determined by the controlling water company.

(3) Each building shall be served by a separate line and meter; however, in some situations a common tap and service line from the main to a manifold with two curb stops and boxes may be installed to serve two adjacent properties. Multiple housing of two units or more shall have a minimum of 1" service line.

(4) All service line taps shall be machine tapped at the time of the water main installation. Service lines shall be installed prior to testing and acceptance of the water main.

(5) Water mains shall be laid at least 10 feet horizontally from any existing or proposed sewer main. The distance shall be measured edge to edge.

(6) When a water main crosses over a sewer main, the water main shall be laid at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer. When the water main cannot be as high as 18 inches above the sewer, the sewer shall be constructed of material with pressure conduit standards for a distance of 20 feet on either side

of the crossing.

(7) All tees, bends, plugs and hydrants shall be provided with reaction blocking, tie rods or joints designed to prevent movement. Wood blocking of future main extensions are not acceptable. Concrete thrust blocks shall be formed and poured in place and must bear against undisturbed soil.

(8) Air release vacuum assemblies and blow-off valves shall be provided on all mains larger than 12 inches where required to prevent damage due to air accumulations.

SECTION 3

EARTHWORK

3.1 GENERAL: This section defines the requirements for excavation and backfill for structures; construction requirements for embankments and fills; sub-grade preparation for pavements and other surface improvements.

3.2 DEFINITIONS:

EMBANKMENT shall refer to any raised area of compacted earth to support a roadway, structure, parking lot, etc. The material used for embankment shall be specified, and tests shall be performed to determine the fill material's adequacy for the specific project.

FILL shall refer to any material used to fill a depression, and can be any material which can be compacted enough to prevent settlement such as earth, broken-up concrete, old building blocks, crushed stone or material from a riverbank, etc. (Embankment is a type of fill.)

BACKFILL shall refer to any earth that has been excavated from a trench or other excavation and then replaced and compacted as specified after the structure has been installed.

3.3 EXCAVATION: All structures shall be founded on undisturbed original sub-soil or engineered fill. All unauthorized excavation below the specified structure sub-grade shall be replaced with concrete or untreated base course thoroughly compacted to a minimum of 95% of maximum dry density. Sub-grade soil for all concrete structures, regardless of type or location, shall be firm and thoroughly compacted to a minimum of 95% of maximum dry density.

Coarse gravel or crushed stone may be used for sub-soil reinforcement when approved by the County Engineer. Such material shall be applied in six inch layers, each layer being embedded in the sub-soil by thorough tamping. All excess soil shall be removed to compensate for the displacement of the gravel or crushed stone and the finished elevation of any sub-soil reinforced in this manner shall not be above the specified sub-grade.

TABLE 3.1
HIGHWAY SUB-GRADE MATERIALS CLASSIFICATION

GENERAL CLASSIFICATION					CHARACTERISTICS OF				
	GROUP CLASSIFICATION				FRACTION PASSING NUMBER 40 SIEVE		G R O U P I N D E X	USUAL TYPES OF SIGNIFICANT CONSTITUENT MATERIALS	GENERAL RATING AS SUB-GRADE
	SIEVE ANALYSIS (PERCENT PASSING)				L.L.	P.I.			
	NO. 10 SIEVE	NO. 40 SIEVE	NO. 200 SIEVE						
G R A N U L A R * S I L T Y -- C L A Y **	A-1	50 MAX.	50 MAX.	25 MAX.	---	6	0	Stone frgnts., gravel, sand	Excellent
	A-2	---	---	35 MAX.	40- 41	10- 11	4 MAX.	Silty or clayey gravel or sand	Good to fair
	A-3	---	51 MIN.	10 MAX.	---	N.P.	0	Fine sand	Fair
	A-4	---	---	36 MIN.	40 MAX.	10 MAX.	8 MAX.	Silty soils	Fair to moderate
	A-5	---	---	36 MIN.	41 MIN.	10 MAX.	12 MAX.	Clayey- silt soils	Moderate
	A-6	---	---	36 MIN.	40 MAX.	11 MIN.	16 MAX.	Silty- clay soils	Moderate to poor
	A-7	---	---	36 MIN.	41 MIN.	11 MIN.	20 MAX.	Clayey soils	Poor

* Thirty-five percent or less passing Number 200 Sieve.

** More than thirty-five percent passing Number 200 Sieve.

3.4 BACKFILLS: Backfill shall be placed to the lines shown on the approved drawings, or as directed by the Engineer. After completion of construction below the elevation of the final grades, and prior to backfilling, the excavation shall be cleaned and all forms, trash and debris shall be removed. Backfill material shall consist of approved excavated material or clean borrow of sand,

gravel or other suitable material, and shall be placed in layers not exceeding six inches in compacted thickness. Each layer shall be compacted by hand or machine tampers or by other suitable equipment to a minimum density of 95% of maximum dry density.

3.5 CONSTRUCTION OF EMBANKMENTS: Unsuitable materials that occur in the foundations for embankments shall be removed by clearing, stripping and/or grubbing. Soils used as roadway embankment material shall be A-4 classification or better as detailed in Table 3.1 (Highway Sub-grade Materials Classification). All materials in embankments shall be placed, moistened, and compacted as provided in the following paragraphs.

When the embankment exceeds the amount of excavation, sufficient additional material shall be obtained from borrow pits provided by the Contractor. All material proposed to be imported shall be subject to the review and approval of the Engineer prior to starting of hauling operations. The materials used for embankment construction shall be free from sod, grass, trash, rocks larger than three inches in diameter and all other material unsuitable for construction of embankments.

Grading of completed embankments and backfills shall bring the surfaces to a smooth, uniform condition with final grades being within 0.1 foot of the design grade. Cut and fill slopes shall be designed to prevent sloughing and erosion. Soils testing shall be required where necessary to establish the maximum angle of repose.

3.6 COMPACTION OF EARTH MATERIALS: The fill material shall be deposited in horizontal layers having a thickness of not more than eight inches and then compacted to the specified density as herein specified. Moisture content during compaction operations shall be near optimum for granular soils and at two to five percent above optimum for fine grained soils. The moisture content shall be uniform throughout the layers.

If the moisture content is greater than optimum for compaction, the compaction operations shall be delayed until such time as the material has dried to the optimum moisture content. When the material has been conditioned as hereinbefore specified, the backfill or embankment shall be compacted as follows:

Under roadways, curb and gutter, sidewalks, and driveways and extending one foot beyond the proposed construction, the embankment material shall be compacted to a density equal to not less than 95% for granular soils or 90% of maximum dry density for fine grained soils. Other fills and embankments not listed above shall be compacted to 90% maximum dry density.

Exposed natural soils within building areas, beneath walkways, slabs and pavement shall be scarified to a depth of six inches, moisture conditioned, and compacted to the specified density. Where hard, cemented material or rock is exposed, scarification is not necessary.

Foundations for structures shall not be placed partially on undisturbed soil or compacted fill and

partially on cemented deposits or rock.

Foundation soil shall not be allowed to become saturated during or after construction.

3.7 ROAD SUB-GRADE PREPARATION: Where required by the Engineer, the sub-grade shall be scarified to a depth of eight inches prior to compaction operations. The road sub-grade shall be compacted to the equivalent of 95% of maximum dry density as measured by ASTM (D 2922 2937 2167 1556) specifications. No rocks larger than two inches in diameter, organic material, soft clay, spongy material or other deleterious material will be permitted in the sub-grade. Sub-grades shall be shaped and graded to within a tolerance of 0.10 foot of design grade and drainage shall be maintained at all times. Sub-grades shall be stabilized and compacted as directed by the Engineer. Any springs or underground water encountered in the construction of the streets shall be properly disposed of in accordance with the instructions of the County Engineer.

When required to demonstrate the stability and compaction of the sub-grade, the contractor shall proof-roll the sub-grade prior to laying any base gravel. The sub-grade shall be proof-roller with at least one pass coverage with a pneumatic tired roller of at least ten-ton capacity. All proof-rolling shall be accomplished in the presence of the engineer. Ground contact pressure for all tires shall be 85 to 90 psi.

When the proof rolling shows an area to be unstable, it shall be brought to satisfactory stability by additional compaction, reworking, or removal of unsuitable material and replacement with acceptable material.

3.8 CONSTRUCTION OF NON-STRUCTURAL FILLS: Fills shall be placed to the lines shown on the drawings and shall be any areas not specifically designated for support of structures or utilities (such as landscape areas, open space areas, etc.). Fill material shall have no specific compaction requirements but shall consist of material that can be compacted to prevent settlement such as rocks, old building blocks, crushed stone, broken-up concrete, boulders, etc. Fill material shall not include deleterious materials such as muck, ash, sod, grass, trash, tree stumps, lumber, dead animals, etc.

SECTION 4

ROADWAY CONSTRUCTION

4.1 GENERAL: This section covers the requirements for construction of roadway pavements including base course, bituminous prime coat, bituminous surface course, and bituminous seal coat.

Pavement structure shall comply with Table 4.1 unless required engineering studies support another preferable design.

**TABLE 4.1
ROAD CROSS SECTION STANDARDS**

TYPE OF ROAD						
	RESIDENTIAL	COLLECTOR AND ARTERIAL	INDUSTRIAL (For Zones M-1; M-2; C-2; C-3)			
SUB-GRADE QUALITY*	GOOD	POOR	GOOD	POOR	GOOD	POOR
ASPHALTIC CONCRETE	2"	2"	2.5"	2.5"	3"	3"
GRAVEL (ROADBASE) -TYPE II-	6"	4"	4"	6"	4"	6"
GRAVEL (PIT-RUN)** -TYPE I-	---	10"	4"	10"	6"	12"
TOTAL SECTION THICKNESS	8"	16"	10.5"	18.5"	13"	21"

AASHTO Classification of Soil

- * Sub-grade quality terms are defined as follows:
GOOD: Table II, Classifications A-1, A-2, A-3, and A-4.
POOR: Table II, Classifications A-5, A-6, and A-7.

** Crushed road base gravel (type I) may be used in lieu of pit run gravel with a reduction of 2 inches in thickness, if preferred.

4.2 BASE COURSE: Base for all streets shall consist of select materials, either natural or crushed. Prior to placing untreated base course, the Contractor shall submit, in writing, a job-mix gradation to the Engineer for his approval. The job-mix gradation shall have definite single values for the percentage of aggregate passing each specified sieve based on the dry weight of the aggregate. The job-mix gradation shall meet the ideal gradation shown in table 4.2 unless other job-mix designs are submitted and approved by the County Engineer prior to laying.

Base course material shall be deposited and spread in uniform lifts not to exceed six inch compacted thickness, without segregation of size. When compacted the base shall meet the required thickness. Each layer shall be compacted for the full width and depth by rolling with a pneumatic roller weighing at least 10 tons. Alternate blading and rolling will be required to provide a smooth even and uniformly compacted course true to cross-section and grade. Places inaccessible to rolling shall be compacted with mechanically operated hand tampers. The gravel base shall be compacted to not less than 95% maximum dry density as determined by ASTM specifications.

**TABLE 4.2
IDEAL GRAVEL GRADATION**

SIEVE SIZE	PERCENT PASSING TYPE I (PIT-RUN)	PERCENT PASSING TYPE II (3/4" ROADBASE)	PERCENT PASSING OF TOTAL AGGREGATE (DRY WEIGHT) 1" TYPE II ROADBASE
3"	100	—	---
2"	90 - 100	—	---
1"	70 - 90	—	100
3/4"	—	100	---
1/2"	50- 75	---	79 - 91
3/8"	---	78 - 92	—
#4	30-65	55 - 67	49 - 61
#16	15-40	28 - 38	27 - 35
#50	---	—	—
#200	2 - 12	7 - 11	7 - 11

1. Roadbase for all streets shall consist of clean, hard, tough, durable and sound mineral aggregates that consist of crushed stone, crushed gravel, or crushed slag; free of deleterious and/or organic materials.
2. Dry-rodded unit weight shall be at least 75 pounds per cubic foot.
3. Material-passing the number 40 sieve shall be non-plastic.
4. Aggregate wear under ASTM - C-131 or AASHTO T-96 shall be less than 50%.
5. All gravel pits supplying aggregate must be UDOT approved pits or pass Items 2-3 & 4 above and be certified to by an independent soils engineer or testing lab.
6. The "Job Mix Target" gradation of the aggregate shall fall within the following band limits.

TARGET ACCEPTANCE BAND LIMITS					
MEAN OF THE DEVIATIONS OF SIEVE GRADATION					
RESULTS FROM THE JOB MIX TARGET					
SIEVE SIZE	Expressed in Percentage Points				
	1 Test	2 Tests	3 Tests	4 Tests	
1/2 inch (and larger)	+/- 15	+/- 12.1	+/- 10.8	+/- 10.0	+/- 9.5
3/8 inch	+/- 15	+/- 11.5	+/- 9.8	+/- 8.8	+/- 8.0
No. 4	+/- 14	+/- 10.5	+/- 8.8	+/- 7.8	+/- 7.0
No. 16	+/- 11	+/- 8.2	+/- 6.9	+/- 6.2	+/- 5.6
No. 200	+/- 4.5	+/- 3.4	+/- 2.9	+/- 2.5	+/- 2.3

There is no acceptance of road base based on a reduced payment or pay factor on development related projects. Reduced payments and pay factors are only for use on County-managed (capital improvement projects). Roadbase which does not meet the above tolerances shall be removed and replaced with material meeting the required gradation as outlined or the material may be blended with additional material to bring it within specification limits.

If a project or a supplier does not submit and have an approved target gradation prior to placement of material then acceptance will be based upon the gradation band limits as noted in No. 6 above. The target acceptance band limits will not apply.

4.3 BITUMINOUS PRIME COAT: The bituminous prime coat shall consist of an application of hot bituminous material MC-70 on a previously prepared surface course. Bituminous material for the prime coat shall be applied at the rate of 0.25 gall per square yard of surface course and only when the minimum temperature of the air or road bed is 50° and rising. Application conditions shall be subject to the discretion of the County Engineer.

Immediately prior to the application of the prime coat, all loose material, dirt, clay, or other objectionable material, shall be removed from the surface to be primed. After the cleaning operation, and prior to the application of the prime coat, the surface shall be steel rolled and lightly sprinkled with water immediately in advance of the application as directed by the Engineer, to assure a uniform spread of the bituminous material.

Immediately following the preparation of the base course, the bituminous prime material shall be applied by means of a bituminous distributor at the temperature specified. The priming material shall be so applied that uniform distribution is obtained at all points of the surface to be primed or treated. (The distributor shall be equipped so as to obtain satisfactory pressure at the spray nozzles so that flow through the sprays can be started and stopped immediately and that all spray nozzles will be operating at full force on the surface to be treated at all times.) All spots unavoidably missed by the distributor shall be properly treated with bituminous material.

Following the application of prime material, the surface shall be allowed to dry for a period of not less than 48 hours without being disturbed, or of such additional period of time as may be necessary to attain penetration into the foundation course and drying out or evaporation of the volatiles from the prime material, which period shall be determined by the County Engineer. The contractor shall furnish and spread sufficient approved sand on all areas which show an excess of bituminous material to effectively blot up and cure the excess, as directed by the County Engineer. The primed surface shall be maintained by the contractor and he shall repair all broken spots.

4.4 BITUMINOUS SURFACE COURSE: Over the cured prime coat the contractor shall place and compact a bituminous surface course. The surface course shall consist of a mixture of mineral aggregate and binder. The supplier shall submit a design mix to the County Engineer for his approval prior to the commencement of each construction season or upon selection of new aggregate sources. The design mix gradation shall meet the ideal gradation shown in table 4.3 unless other job-mix designs are submitted and approved by the County Engineer prior to laying.

TABLE 4.4
ACCEPTANCE SCHEDULE FOR BASE COURSE AGGREGATE GRADATION
(Percentage Points)

**MEAN OF THE DEVIATIONS FROM THE ACCEPTED
GRADATION SPECIFICATION FOR VARIOUS
QUANTITIES OF TESTS (PERCENTAGES)**

SIEVE SIZE	PAY FACTOR	1 TEST	2 TESTS	3 TESTS	4 TESTS	5 TESTS
HALF INCH AND LARGER	1.00	0-15	0-12.1	0-10.8	0-10.0	0-9.5
	0.95	16-17	12.2-13.9	10.9-12.4	10.1-11.5	9.6-11.0
	0.90	18-19	14.0-15.1	12.5-13.5	11.6-12.5	1.1-11.9
	0.80	20-21	15.2-17.2	13.6-15.3	12.6-14.2	2.0-13.5
	0.70	22-23	17.3-18.8	15.4-16.7	14.3-15.5	3.6-14.7
3/8 INCH	1.00	0-15	0-11.5	0-9.8	0-8.8	0-8.0
	0.95	16-17	11.6-13.2	9.9-11.3	8.9-10.1	8.1-9.2
	0.90	18-19	13.3-14.4	11.4-12.3	10.2-11.0	9.3-10.0
	0.80	20-21	14.5-16.3	12.4-13.9	11.1-12.5	0.1-11.4
	0.70	22-23	16.4-17.8	14.0-15.2	12.6-13.6	1.5-12.4
NO. 4	1.00	0-14	0-10.5	0-8.8	0-7.8	0-7.0
	0.95	15-17	10.6-12.1	8.9-10.1	7.9-9.0	7.1-8.0
	0.90	18	12.2-13.1	10.2-11.0	9.1-9.8	8.1-8.7
	0.80	19-20	13.2-14.9	11.1-12.5	9.9-11.1	8.8-10.0
	0.70	21-22	15.0-16.3	12.6-13.6	11.2-12.1	0.1-10.8
NO. 16	1.00	0-11	0-8.2	0-6.9	0-6.2	0-5.6
	0.95	12-13	8.3-9.4	7.0-7.9	6.3-7.1	5.7-6.4
	0.90	14	9.5-10.3	8.0-8.6	7.2-7.8	6.5-7.0
	0.80	15-16	10.4-11.6	8.7-9.8	7.9-8.8	7.1-8.0
	0.70	17	11.7-12.7	9.9-10.7	8.9-9.6	8.1-8.7
NO. 50	1.00	0-9	0-7.0	0-6.1	0-5.5	0-5.2
	0.95	10	7.1-8.0	6.2-7.0	5.6-6.3	5.3-6.0
	0.90	11	8.1-8.8	7.1-7.6	6.4-6.9	6.1-6.5
	0.80	12-13	8.9-10.0	7.7-8.7	7.0-7.8	6.6-7.4
	0.70	14	10.1-10.9	8.8-9.5	7.9-8.5	7.5-8.1
NO. 200	1.00	0-4.5	0-3.4	0-2.9	0-2.5	0-2.3
	0.95	4.6-5.2	3.5-3.9	3.0-3.3	2.6-2.9	2.4-2.6
	0.90	5.3-5.6	4.0-4.3	3.4-3.6	3.0-3.1	2.7-2.9
	0.80	5.7-6.4	4.4-4.8	3.7-4.1	3.2-3.6	3.0-3.3
	0.70	6.5-7.0	4.9-5.3	4.2-4.5	3.7-3.9	3.4-3.6

4.4(a) CONSTRUCTION METHODS AND EQUIPMENT: The methods employed in performing the work, all equipment, tools and machinery and other appliances used in handling the materials and executing the work shall be the responsibility of the contractor. The contractor shall make such changes in the methods employed and in the equipment used as are necessary whenever the bituminous pavement being produced does not meet the specifications herein established.

4.4(b) SPREADING AND COMPACTION: The bituminous mixtures shall be spread with self-propelled mechanical spreading and conditioning equipment capable of distributing at least a 12 foot width. The spreader shall be equipped with an automatic leveling screed. The mixture shall be spread and struck off in such a manner that the finished surface will result in a uniform smooth surface. The longitudinal joints in succeeding courses shall be off-set at least 12 inches vertically to avoid a vertical joint through more than one course. All transverse joints shall be off-set from one another at least four feet longitudinally, except as required by the Engineer. The temperature of the bituminous mix shall be between 250° and 325° F. when placing.

After the mixture has been spread the surface shall be rolled in longitudinal direction commencing at the outside edge of lower side and proceeding to the higher side. Each pass of the roller shall overlap the preceding pass at least 1/2 the width of the roller. Rolling shall continue until 96% of the laboratory density as determined in accordance with ASTM Designation D-1559 for the bituminous mixture being used has been obtained. Density determination of bituminous mixture shall be determined in accordance with ASTM D 2950. Rolling operations shall be conducted in such a manner that shoving or distortion will not develop beneath the roller.

The surface of the pavement, after compaction, shall be uniform and true to the established crown and grade. all traffic shall be kept off the surface until rolling is completed.

4.5 QUALITY CONTROL:

4.5(a) BASE COURSE: Acceptance of base course with respect to gradation shall be based on the average gradation. If any average sieve gradation deviates from the job mix gradation more than the maximum value shown under the 1.00 pay factor in Table 4.4, and if the contractor elects not to remove, re-blend, or replace the base course, the engineer may, at his discretion, accept it at an adjusted unit price.

Acceptance of gradation shall be based on the average of all gradation tests made in sections of approximately 15,000 square feet. If any average gradation deviates from the job mix gradation for any particular sieve more than the maximum value shown under the 0.70 pay factor in Table 4.4, the Engineer may order the correction or removal of any or all of the base course in the tested section. The pay factor for such base course which is allowed to remain in place shall be 0.50. The computation of the adjusted unit price for untreated base course shall be based upon the minimum pay factor determined from Table 4.4, and values established by the County for aggregate at the crusher site. Said values shall be based on retail prices.

In addition to the random acceptance samples taken from each area, the Engineer may sample the untreated base from any portion of the course that exhibits a non-uniform appearance.

The contractor shall take steps to bring the untreated base course into specifications when the test results show any average deviation from the job mix gradation that exceeds the maximum allowed under the 1.00 pay factor in Table 4.4.

4.5(b) BITUMINOUS SURFACE: Acceptance of bituminous surface course with respect to gradation and bituminous content shall be based on the deviation of the averages from the job-mix formula. The job-mix formula refers to the job-mix gradation and the required bitumen content. If any average sieve or bitumen content deviates from the job-mix formula more than the maximum shown under the 1.00 pay factor in Tables 4.5a or 4.5b, and if the contractor elects not to remove or replace it, the Engineer may at his discretion accept it at an adjusted price.

If any average sieve or bitumen content deviates from the job-mix formula more than the maximum value shown under the 0.70 pay factor in Tables 4.5a or 4.5b, the Engineer may order the correction or removal of any or all of the bituminous surface course in the area. The pay factor for such bituminous surface course allowed to remain in place shall be 0.50.

TABLE 4.5a
ACCEPTANCE SCHEDULE FOR BITUMEN CONTENT OF BITUMINOUS MIXTURE

**MEAN OF THE DEVIATIONS FROM THE ACCEPTED
BITUMEN CONTENT SPECIFIED FOR THE
JOB-MIX FORMULA (PERCENTAGES)**

PAY FACTOR	1 TEST	2 TESTS	3 TESTS	4 TESTS	5 TESTS
1.00	0-0.7	0-.54	0-.46	0-.41	0-.38
0.95	0.8	.55-.61	.47-.52	.42-.46	.39-.43
0.90	0.9	.62-.68	.53-.58	.47-.51	.44-.47
0.80	1.0	.69-.75	.59-.64	.52-.56	.48-.52
0.70	1.1	.76-.82	.65-.69	.57-.61	.53-.56

The computation of the adjusted unit price for bituminous surface course shall be based upon the minimum pay factor determined from Table 4.5a and 4.5b and values established by the County for aggregate and asphalt. Said values shall be based on retail prices and will be adjusted in January and June of each year. Acceptance of bituminous surface course with respect to density shall be based on the average of all density determinations made in sections of approximately 15,000 square feet.

Acceptance shall be made when the average of all density determinations made in a section is not less than 96% of the maximum laboratory density and when no single determination is lower than 92% of the maximum density.

If an individual test result falls below 95% of the maximum laboratory density (Marshall) or 92% of the measured maximum density (Rice Method), the surface course material represented by that test will be considered defective and the contractor shall further compact the section. After further compaction, the original test site and one other randomly selected site within the section shall be tested. The average of the two tests results shall be included in determining the mean density for the selection. The original test results shall not be included. If the section does not meet the required density after the second test is performed, the process of recompacting and retesting shall be repeated until the minimum compaction requirement is obtained.

TABLE 4.5b
ACCEPTANCE SCHEDULE FOR AGGREGATE GRADATION
OF BITUMINOUS MIXTURE

MEAN OF THE DEVIATIONS FROM THE ACCEPTED
GRADATION SPECIFICATION FOR THE JOB-MIX
FORMULA (PERCENTAGES)

GRAD- ATION	PAY FACTOR	1 TEST	2 TESTS	3 TESTS	4 TESTS	5 TESTS
HALF INCH AND LARGER	1.00	0-10	0-7.3	0-6.3	0-5.6	0.52
	0.95	11-12	7.4-8.3	6.4-7.1	5.7-6.3	5.3-5.8
	0.90	13	8.4-9.3	7.2-7.9	6.4-7.0	5.9-6.4
	0.80	14	9.4-10.3	8.0-8.7	7.1-7.7	6.5-7.1
	0.70	15	10.4-11.3	8.8-9.5	7.8-8.4	7.2-7.7
3/8 INCH SIEVE	1.00	0-9	0-6.9	0-5.9	0-5.3	0-4.9
	0.95	10	7.0-7.8	6.0-6.6	5.4-5.9	5.0-5.5
	0.90	11	7.9-8.7	6.7-7.3	6.0-6.6	5.6-6.1
	0.80	12-13	8.8-9.6	7.4-8.0	6.7-7.2	6.2-6.6
	0.70	14	9.7-10.5	8.1-8.9	7.3-7.9	6.7-7.2
NO. 4 SIEVE	1.00	0-9	0-6.7	0-5.7	0-5.2	0-4.8
	0.95	10	6.8-7.6	5.8-6.3	5.3-5.8	4.9-5.4
	0.90	11	7.7-8.5	6.4-6.9	5.9-6.4	5.5-5.9
	0.80	12-13	8.6-9.4	7.0-7.5	6.5-7.0	6.0-6.5
	0.70	14	9.5-10.2	7.6-8.0	7.1-7.6	6.6-7.0
NO. 8 SIEVE	1.00	0-7	0-5.6	0-4.8	0-4.3	0-4.0
	0.95	8	5.7-6.3	4.9-5.4	4.4-4.8	4.1-4.5
	0.90	9	6.4-7.0	5.5-6.0	4.9-5.3	4.6-4.9
	0.80	10	7.1-7.7	6.1-6.6	5.4-5.8	5.0-5.4
	0.70	11-12	7.8-8.5	6.7-7.2	5.9-6.4	5.5-5.8
NO. 16 SIEVE	1.00	0-7	0-5.2	0-4.6	0-4.2	0-1.7
	0.95	8	5.3-5.8	4.7-5.1	4.3-4.6	4.0-4.3
	0.90	9	5.9-6.4	5.2-5.6	4.7-5.1	4.4-4.7
	0.80	10	6.5-7.0	5.7-6.1	5.2-5.5	4.8-5.1
	0.70	11	7.1-7.6	6.2-6.6	5.6-5.9	5.2-5.4
NO. 50 SIEVE	1.00	0-6	0-2.4	0-3.8	0-3.4	0-3.2
	0.95	7	4.4-4.8	3.9-4.1	3.5-3.8	3.3-3.5
	0.90	8	4.9-5.3	4.2-4.5	3.9-4.1	3.6-3.8
	0.80	9	5.4-5.8	4.6-4.9	4.2-4.4	3.9-4.1
	0.70	0	5.9-6.4	5.0-5.5	4.5-4.9	4.2-4.5
NO. 200 SIEVE	1.00	0-3.0	0-2.4	0-2.0	0-1.8	0-1.7
	.95	3.1-3.5	2.5-2.7	2.1-2.2	1.9-2.0	1.8-1.9
	.90	3.6-4.0	2.8-3.0	2.3-2.4	2.1-2.2	2.0-2.1
	.80	4.1-4.5	3.1-3.3	2.5-2.7	2.3-2.4	2.2-2.3
	.70	4.6-5.0	3.4-3.6	2.8-3.0	2.5-2.6	2.4-2.5

In addition to the above acceptance tests, the Engineer shall reserve the right to test any area which appears to be defective and shall require further compaction of areas that do not meet at least 92% of maximum laboratory density or 89% of measured maximum density.

If the average density of the surface course placed in any day does not equal or exceed 96% of maximum laboratory density or 93% of measured maximum density, but not below 92% of maximum laboratory density or 89% of measured density, the lot may be accepted at a reduced price upon written request from the contractor. The computation of the adjusted unit price for the bituminous

surface course with respect to density shall be based upon a pay factor of 0.90. Any area with a density below 92% of maximum laboratory density or 89% of measured maximum density shall be considered defective. The Engineer may order the removal of any or all of the bituminous mix in that section. The pay factor for any such surface course which is allowed to remain in place shall be 0.50 of the bid price of asphalt in place.

The pavement surface shall be tested for smoothness as the work progresses. Longitudinal and transverse measurement shall be made with a 25 foot string line. The variation of the surface from the testing edge of the string line between any two contacts with the surface shall at no point exceed 1/4 inch. All humps or depressions exceeding the specified tolerances shall be corrected at the expense of the contractor as directed by the Engineer.

Acceptance of the completed bituminous surface course with respect to thickness shall be based on the average thickness in sections of approximately 15,000 square feet. Acceptable thickness shall not be less than requirements in Table 4.1. Section that are not acceptable due to a deficiency in shall be brought into compliance by placing additional surface course as directed by the Engineer.

For subdivision construction the owner shall pay a penalty equal to all reductions in payment to the County before acceptance by the County.

4.6 BITUMINOUS SEAL COAT (CHIP SEAL): Bituminous surface treatments (chip seals) shall be applied to the road surface only upon approval of the County Engineer. The bituminous surface treatment shall consist of an application of bitumen covered with mineral aggregate and rolled to a smooth surface presenting an even texture. The materials used in the application of the bituminous surface treatment shall be mineral aggregate and bituminous material.

4.6(a) BITUMINOUS MATERIAL: The bituminous material shall be cationic emulsified asphalt (type CRS-2), with a Saybolt Furol viscosity (at 122° F) of between 300 and 400 seconds, and shall conform to the requirements as outlined in AASHTO Designation M208. The bituminous material shall also conform to the following requirements:

1. Sieve limit of 0.10 percent.
2. The particle charge shall be positive.
3. The Residue by evaporation shall be 65% by weight, minimum.
4. The results of the test on residue from distillation (tested in accordance with ASTM D-244) shall be as follows:

TESTS	MINIMUM	MAXIMUM
Penetration	100 mm.	250 mm.
Ductility	40 cm.	100 cm.
Solubility in trichloroethylene	97.5%	100%

The bituminous material shall be applied at 0.40 to 0.60 gallon per square yard as determined by the Engineer and at a temperature between 125° F. to 185° F. The exact temperature used to apply the bituminous material shall be determined by the Engineer.

4.6(b) AGGREGATE (CHIPS): Mineral aggregate shall consist of crushed stone or crushed gravel, free from adherent films of clay or dust, and shall be of such nature that a thorough coating of the bituminous material used in the work will not strip off upon contact with water.

The gravel or rock shall have a percent of wear not greater than 30 when tested by the Los Angeles Abrasion Test (AASHTO T-9 ASTM C 131). Chips shall be cubical or pyramidal in shape with at least 95% fractured faces. The crushed aggregate shall have a weighted percent of loss not exceeding 10% by weight when subjected to five cycles of sodium sulfate and tested in accordance with AASHTO Designation T-104.

Stripping tests of the mineral aggregate which the contractor proposes to use shall be furnished the Engineer before crushing operations begin. During the crushing of the aggregate, additional stripping tests shall be furnished to the Engineer upon his request. No stripping test shall show a percent stripping greater than 10 for CRS-2 asphalt. The chip shall be electrically compatible to the asphalt emulsion used.

The crushed aggregate shall conform to the gradation requirements shown in Table 4.6.

surface course with respect to density shall be based upon a pay factor of 0.90. Any area with a density below 92% of maximum laboratory density or 89% of measured maximum density shall be considered defective. The Engineer may order the removal of any or all of the bituminous mix in that section. The pay factor for any such surface course which is allowed to remain in place shall be 0.50 of the bid price of asphalt in place.

The pavement surface shall be tested for smoothness as the work progresses. Longitudinal and transverse measurement shall be made with a 25 foot string line. The variation of the surface from the testing edge of the string line between any two contacts with the surface shall at no point exceed 1/4 inch. All humps or depressions exceeding the specified tolerances shall be corrected at the expense of the contractor as directed by the Engineer.

Acceptance of the completed bituminous surface course with respect to thickness shall be based on the average thickness in sections of approximately 15,000 square feet. Acceptable thickness shall not be less than requirements in Table 4.1. Section that are not acceptable due to a deficiency in shall be brought into compliance by placing additional surface course as directed by the Engineer.

For subdivision construction the owner shall pay a penalty equal to all reductions in payment to the County before acceptance by the County.

4.6 BITUMINOUS SEAL COAT (CHIP SEAL): Bituminous surface treatments (chip seals) shall be applied to the road surface only upon approval of the County Engineer. The bituminous surface treatment shall consist of an application of bitumen covered with mineral aggregate and rolled to a smooth surface presenting an even texture. The materials used in the application of the bituminous surface treatment shall be mineral aggregate and bituminous material.

4.6(a) BITUMINOUS MATERIAL: The bituminous material shall be cationic emulsified asphalt (type CRS-2), with a Saybolt Furol viscosity (at 122° F) of between 300 and 400 seconds, and shall conform to the requirements as outlined in AASHTO Designation M208. The bituminous material shall also conform to the following requirements:

1. Sieve limit of 0.10 percent.
2. The particle charge shall be positive.
3. The Residue by evaporation shall be 65% by weight, minimum.
4. The results of the test on residue from distillation (tested in accordance with ASTM D-244) shall be as follows:

4.7(a) ASPHALT EMULSION: The asphalt emulsion shall conform to the specifications outlined in Tables 4.7a, 4.7b, and 4.7c. Either cationic or anionic emulsion may be used, whichever is best suited to the aggregate and job conditions to be encountered, as determined by compatibility tests and procedures as specified in the latest edition of the ISSA Technical Bulletin #115.

to roll over after striking the bituminous-covered surface will not be permitted.

Excess aggregate deposited in localized areas shall be immediately removed with square-end shovels, and in areas where application is insufficient, additional aggregate shall be added by hand. The treated surface shall be rolled with rubber-tired rollers immediately after the distribution of the cover aggregate, and shall continue until the aggregate is properly seated in the binder. Rollers shall proceed in the longitudinal direction, working across the treated surface until the entire width and length of the treated surface has been rolled at least four times. Rollers and gravel trucks shall not be operated at speeds great enough to kick up chips, and in no case shall rollers be operated above 10 miles per hour. In all places not accessible to the rollers, the aggregate shall be adequately compacted with hand tampers. Any aggregate that becomes coated or mixed with dirt or any other foreign material shall be removed, replaced with clean aggregate over a newly sprayed surface and then re-roller, as directed by the Project Engineer.

Bituminous material and chips shall not be spread more than 100 feet ahead of completion of initial rolling operations.

To eliminate excessive ridging, all joint edges shall be swept prior to the application of the second course of aggregate on double chip seal treatments.

Upon completion of rolling, traffic will be allowed to use the streets at a speed not to exceed 15 miles per hour for a period of not less than 24 hours. After the chips are set in the bituminous binder, but not earlier than the following day, any loose chips forming corrugations shall be distributed over the surface. At the end of seven days any excess chips shall be removed in such a manner that the aggregate set in the binder will not be displaced. Excessive rolling or brooming will not be permitted.

After the surface has been opened to traffic, any excess bituminous binder that comes to the surface shall be immediately covered with additional chips or clean sand. The completed surface shall present a uniform appearance and shall be thoroughly compacted and free from ruts, humps, depressions or irregularities due to an uneven distribution of bituminous binder or chips.

4.6(i) WEATHER LIMITATIONS: The chip seal shall be placed only when the air temperature in the shade of the road bed temperature are above 75° F. The chip seal shall not be placed when the temperature of the road surface is above 130° F, during rainy weather, when the base is wet or during other unfavorable weather conditions as determined by the Project Engineer.

4.7 SLURRY SEAL: The slurry seal shall consist of a mixture of emulsified asphalt, mineral aggregate, mineral filler, set control additive, and water; properly proportioned, mixed and spread evenly on a prepared surface in accordance with these specifications, or as directed by the County Engineer. The slurry, when cured, shall have a homogeneous appearance, fill all cracks, adhere firmly to the road surface, and have a skid resistant texture.

4.7(a) ASPHALT EMULSION: The asphalt emulsion shall conform to the specifications outlined in Tables 4.7a, 4.7b, and 4.7c. Either cationic or anionic emulsion may be used, whichever is best suited to the aggregate and job conditions to be encountered, as determined by compatibility tests and procedures as specified in the latest edition of the ISSA Technical Bulletin #115.

TABLE 4.7b
SLURRY SEAL TEST SPECIFICATIONS

T E S T S O N R E S I D U E

TESTS	TEST METHOD	TEST METHOD	TYPE OF EMULSION		TYPE OF EMULSION	
	AASHTO	ASTM	ANIONIC		CATIONIC	
			SLOW SETTING	QUICK SETTING	SLOW SETTING	QUICK SETTING
			SS-1 SS-2 OR SS-1H	QS-H	SS-K or CSS-1	QS-K or QS-KH
PENETRATION 100 gm. @ 77° for 5 Seconds	T49	D5	100 to 200 mm	40 to 100 mm	100 to 200 mm	40 to 100 mm
SOLUBILITY IN TRI- CHLORO- ETHYLENE	---	D2042 4d	97.5% minimum		97.5% minimum	
DUC- TILITY, 5 cm/mm @ 77° F	T51	D113	40 cm. minimum		40 cm. minimum	

TABLE 4.7a
SLURRY SEAL TEST SPECIFICATIONS
TESTS ON EMULSIONS

TESTS	TEST METHOD	TEST METHOD	TYPE OF EMULSION	TYPE OF EMULSION
	AASHTO	ASTM	ANIONIC	CATIONIC
			SLOW SETTING QUICK SETTING	SLOW SETTING QUICK SETTING
			SS-1 SS-2 OR QS-H SS-1H	SS-K or QS-K or CSS-1 QS-KH
PARTICLE CHARGE TEST	---	D244, 18-20	NEGATIVE	POSITIVE
FUROL VISCOSITY 60 ml., @ 77° F., 5 SECONDS	T59, 2b1	D88	15 TO 50	15 TO 50
RESIDUE BY EVAPORATION	T59, 2a3	D244, 12-17	60% by weight, minimum	60% by weight, minimum
SETTLEMENT AFTER 5 DAYS	T59, 2c2	D244, 28-31	3% maximum	3% maximum
SIEVE TEST	T59, 2c4	D244, 37-40	0.10% maximum	-----
SIEVE TEST	—	D2397	-----	0.10% maximum
CEMENT MIXING TEST	T59, 203	D244, 32-36	2% maximum	Not applicable

TABLE 4.7c
TABLE 4.7c
SLURRY SEAL TEST SPECIFICATIONS

TESTS ON SLURRY SEAL JOB MIXTURE

TESTS	TEST METHOD	TEST METHOD	TYPE OF EMULSION		TYPE OF EMULSION	
	AASHTO	ASTM	ANIONIC		CATIONIC	
			SLOW SETTING	QUICK SETTING	SLOW SETTING	QUICK SETTING
			SS-1 SS-2 OR SS-1H	QS-H	SS-K or CSS-1	QS-K or QS-KH
MIXING TIME @ 77° F. (ISSA TB #102)	—	---	Not Applicable	120 Sec. Minimum	N/A	120 Sec. Minimum
SET TIME TESTS (30 Minutes) BLOTTER TEST (ISSA TB #102)	—	—	Not Applicable	No Brown Stain	N/A	No Brown Stain
DISPLACEMENT TEST	---	---	Not Applicable	No Displacement	N/A	No Displacement
WATER RESISTANCE TEST @ 30 Min. (ISSA TB #102)	—	—	Not Applicable	No Discoloration	N/A	No Discoloration
WET STRIPPING TEST, COATING (ISSA TB #114)	—	—	90% Minimum		90% Minimum	
SYSTEM COMPATIBILITY	---	---	Compatible		Compatible	

4.7(b) MINERAL AGGREGATE: The mineral aggregate shall consist of angular sand, or crushed stone, that is free from dirt, organic matter, clay balls, adherent films of clay, dust or other objectionable matter. When tested according to AASHTO T 176, the aggregate shall have a sand equivalent of not less than 45, and the aggregate shall be non-plastic. When tested according to AASHTO T 104, the aggregate shall show a loss of not more than 15%, and when tested according

to AASHTO T 96, the aggregate shall show a loss of not more than 35%.

The combined mineral aggregate shall conform to the requirements of table 4.8.

**TABLE 4.8
SLURRY MIXTURE GRADING**

TYPE OF SLURRY	I	II	III
GENERAL USAGE	Crack filling and fine seal	General seal, medium textured surfaces	First and/or second application of two-course slurry, highly textured surfaces.
SIEVE SIZE (USE Standard Series)	% PASSING	% PASSING	% PASSING
3/8 inch		100	100
No. 4	100	90-100	70-90
No. 8	90-100	65-90	45-70
No. 16	65-90	45-70	28-50
No. 30	40-60	30-50	19-34
No. 50	25-42	18-30	12-25
No. 100	15-30	10-21	7-18
No. 200	10-20	5-15	5-15

4.7(c) MINERAL FILLER: The mineral filler shall conform to the requirements of AASHTO M-16 and shall be used to improve the gradation of the aggregate, to provide improved stability and workability of the slurry and to increase the durability of the cured slurry.

4.7(d) SET CONTROL ADDITIVE: To control the setting time of the slurry mixture, an additive shall be added which will retard the set when a cationic emulsion is used, or accelerate the set when an anionic emulsion is used. The set control additive shall be aluminum sulfate or Portland Cement Type I/II, and shall be added to the slurry mix by an approved method that will assure uniform distribution and proper control. The exact amount shall be determined by conditions in the field.

4.7(e) WATER: Water for the slurry mixture shall be potable and free from harmful soluble salts.

4.7(f) SAMPLING AND TESTING: Sources of all materials shall be selected prior to the construction of the project. AASHTO T-2 shall be used for sampling aggregate; AASHTO T-127 shall be used for sampling aggregate; AASHTO T-127 shall be used for sampling mineral filler; and AASHTO T-40 shall be used for sampling asphalt emulsions. Additional samples of materials shall be furnished as directed by the County Engineer during the progress of the work. The contractor's proposed job mix design shall be approved by the County Engineer prior to commencement of construction.

4.7(g) JOB MIX DESIGN: No slurry mixture shall be placed until a mix design submitted by the contractor has been approved by the Engineer. The exact proportions of asphalt emulsion, aggregate, mineral filler, and water to be used in the preparation of the slurry seal shall be determined by an approved testing laboratory experienced in slurry mix design procedures.

Proportions of the slurry mix shall be within the following general limits:

	<u>Type I</u>	<u>Type II</u>	<u>Type III</u>
Residual asphalt content % of dry aggregate	10-16	7.5-13.5	6.5-12

The slurry shall be a homogeneous mixture, sufficiently stable during the entire mixing-spreading period so that the emulsion does not break. There shall be no segregation of the fines from the coarser aggregate, and the liquid portion of the mix shall not float to the surface. If it is established that a satisfactory mixture meeting the requirements specified herein cannot be produced from the materials furnished, the materials shall be rejected and the contractor shall submit new samples.

The wet track abrasion test shall not exceed a maximum wear loss of 75 grams per square foot.

4.7(h) TEST SECTION: Prior to full production, the contractor will be required to place a test section of sixty (60) square yards in an area designated by the Engineer. The test section shall be placed using the same equipment, methods, and mix as will be used on the job.

If the test section should prove to be unsatisfactory, the necessary adjustments to the mix design, equipment, and/or placement methods shall be made. Additional test sections, as required, shall be constructed and evaluated for conformance to the specifications. When test sections do not conform to the specification requirements, the slurry seal shall be replaced. Full production shall not begin without approval of the Engineer.

4.7(i) EQUIPMENT, TOOLS AND MACHINES: The equipment, tools, and machines needed in the performance of the work shall be subject to the approval of the Engineer, and shall be maintained in a satisfactory working condition at all times.

(a) Slurry Mixing Machine: The slurry mixing machine shall be a continuous flow mixing unit, capable of delivering accurately predetermined proportions of aggregate, water and asphalt emulsion to a revolving spiraled multi-blade mixer tank, and of discharging the thoroughly-mixed product on a continuous basis. The aggregate shall be pre-wetted immediately prior to mixing with the emulsion. The mixing unit shall be capable of thoroughly blending all ingredients together without violent action. The mixing machine shall be equipped with an approved fines feeder that provides an accurate metering device or method of introducing a predetermined proportion of mineral filler into the mixer as the aggregate is fed in. The fines feeder shall be used when mineral filler is part of the aggregate blend. The mixing machine shall be equipped with a water pressure system and fog-type spray-bar adequate for completely fogging the surface with up to 0.05 gal/sq.yd., immediately ahead of the spreading equipment. The machine shall be capable of mixing materials at pre-set proportions regardless of the speed of the machine and without changing machine settings.

(b) Slurry Spreading Equipment: Attached to the mixing machine shall be a mechanical-type squeegee distributor, having rubber-like material in contact with the surface to prevent unwanted egress of slurry. It shall prevent loss of slurry on varying grades and crowns by adjustments to assure uniform spread. An appropriate mechanical device for lateral distribution of the slurry shall be operated within the spreader box. There shall be a steering device and a flexible strike-off. The spreader box shall be adjustable to various widths from eight feet upward. The box shall be kept clean, no extensive build-up of asphalt and aggregate on the box being permitted. A one foot wide burlap drag shall be attached to the back of the spreader box to smooth out irregularities in the slurry surface.

(c) Pneumatic-Tired Rollers: Pneumatic tired rollers shall be self-propelled and have wheels mounted on two axles in such a manner that the rear group of wheels will not follow in the tracks of the forward group. Rollers shall be equipped with water tanks and sprinkler apparatus which shall be used to keep the wheels damp and prevent adherence of bituminous materials to the wheels.

(d) Cleaning Equipment: Power brooms, power blowers, air compressors, water flushing equipment, and hand brooms shall be suitable for cleaning the base surface and cracks therein.

(e) Auxiliary Equipment: Hand squeegees, shovels and other equipment shall be provided as necessary to perform the work.

4.7(j) WEATHER LIMITATIONS: The slurry shall not be applied when either atmospheric or pavement temperature is below 50° F., when raining or during periods of abnormally high relative humidity.

4.7(k) PREPARATION OF SURFACE: Prior to applying the slurry, all silt spots and loose or objectionable material shall be cleaned from the existing pavement surface. Any standard cleaning method will be acceptable, except that water flushing will not be permitted in areas where considerable cracks are present in the pavement surface as determined by the County Engineer.

Traffic paint on the surface to be treated that is not tightly bonded to the surface shall be removed.

Areas impregnated with grease, oil, or fuel shall be scrubbed with industrial-type detergent and flushed thoroughly to remove all traces of detergent.

All loose material in cracks shall be removed by the use of compressed air (90 p.s.i. at the nozzle) immediately before sweeping or vacuuming operations.

The County Engineer shall give final approval that the surface has been properly prepared, prior to the application of the slurry.

4.7(l) AGGREGATE LOADING: All aggregate shall be loaded on the slurry mixing machine through a 3/8" opening bar screen set at a 45° angle to the horizontal plane.

4.7(m) WATER FOG: Immediately prior to application of the slurry seal, the surface of the pavement and all crack faces shall be moistened with a fog spray of water, applied at the rate of 0.02 to 0.05 gal/yd from the spray bar on the slurry seal machine. No free water shall be on the surface of the pavement following the fog spray. The rate of application of the fog spray shall be adjusted during the day to suit pavement temperatures, surface texture, humidity, and dryness of the pavement surface.

4.7(n) PREPARATION OF SLURRY: The slurry seal shall be mixed and applied with a slurry machine. The amount and type of asphalt emulsion to be blended with aggregate shall be determined by the laboratory mix design. A minimum amount of water, added as specified by the Engineer, shall be used as necessary to obtain a workable and homogeneous mixture. The slurry mixture shall be of proper consistency with no segregation when deposited on the surface of the pavement and no additional elements shall be added. The slurry mixture shall show no signs of uncoated aggregate or premature breaking of emulsion when applied to the pavement surface. Total time of mixing shall not exceed four minutes.

4.7(o) APPLICATION OF SLURRY: Sufficient quantities of the slurry seal mixture shall be fed into the spreader box such that a uniform and complete coverage of the pavement is obtained. The slurry seal machine shall be operated at such a speed that the amount of slurry in the spreader box shall remain essentially constant.

The slurry seal shall be placed at a rate within the following general limits:

	Type I	Type II	Type III
Pounds of aggregate per square yard:	6-10	10-15	15-20

If a uniform thickness cannot be met with one application due to irregularities in the pavement surface, multiple applications shall be made. Where multiple applications are required, as determined by the Engineer, each application shall be thoroughly cured before another application is placed. The finished slurry thickness per application shall not be less than 1/8 inch for Type I and 3/8 inch for Types II and III.

No build-up of the cured slurry seal mix shall be allowed to collect in the spreader box. No streaks caused by oversized aggregate particles or build-up of slurry mix on squeegees shall be left in the finished surface.

4.7(p) JOINTS: The longitudinal joint between adjacent lanes shall have no visible lap, pinholes, or uncovered areas. Thick spots caused by overlapping shall be smoothed immediately with hand squeegees before the emulsion breaks. Overlaps which occur at transverse joints shall also be smoothed before the emulsion breaks, so that a uniform surface is obtained which contains no breaks or discontinuities.

4.7(q) HANDWORK: Approved squeegees shall be used to spread slurry in areas not accessible to the slurry spreader box. Care shall be exercised in leaving no unsightly appearance from handwork. When doing handwork in small areas, especially fill-in behind the slurry machine, the material shall be squeegeed in the direction of the machine pass.

4.7(r) CURING: Treated areas will be allowed to cure from four to twenty-four hours or until the treated pavement will not be damaged by traffic. The contractor shall protect this area for the full curing period with suitable barricades or markers.

Areas which are damaged before being opened to traffic shall be repaired by the contractor at his expense.

4.7(s) ROLLING: When required, as determined by the Engineer, the slurry seal placed in areas of slow turning traffic or intersections, shall be rolled with a pneumatic roller. Rolling shall begin as soon as the slurry seal has cured sufficiently to prevent displacement or pickup by wheel traffic. Only sufficient water shall be applied to roller wheels to keep them damp. No additives which are potentially harmful to slurry shall be used in the water. Rolling shall continue until all ridges have been smoothed out and a uniform surface is obtained.

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SECTION 5

PORTLAND CEMENT CONCRETE

5.1 GENERAL: This section of the Specifications defines the materials to be used and the requirements for mixing, placing, finishing and curing all Portland cement concrete work on public improvements within the County.

5.2 MATERIALS: The concrete shall be composed of coarse aggregate, fine aggregate, Portland Cement, and water and shall conform to the following requirements:

5.2(a) CEMENT: Portland cement shall be Type V and shall comply with the standard specification for Portland cement, ASTM C 150.

5.2(b) AGGREGATES: Except as otherwise specified herein, concrete aggregates shall conform to all applicable provisions of the latest revision of ASTM Standard Specification C 33:

(1) **Fine Aggregate:** Fine aggregate shall consist of natural sand, or, subject to approval, other inert materials with similar characteristics, having clean, hard, durable, uncoated grains and shall conform to the requirements of these specifications. The amount of deleterious substances shall not exceed the following limits:

MATERIAL	PERCENT (by weight)
Clay lumps	1.00
Coal and lignite	0.50
Material passing No. 200 sieve	3.00
Other deleterious substances such as shale, alkali, mica, coated grains, soft and flaky particles, etc.	3.00

The sum of the percentage of all deleterious substances shall not exceed five percent by weight.

Fine aggregate shall be well graded and shall range in size from fine to coarse within the following percentages by weight:

SIEVE SIZE	PERCENT PASSING (by weight)
3/8 inch	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	2-10

(2) **Coarse Aggregate:** Coarse aggregate shall consist of crushed stone, gravel, slag or other approved inert material with similar characteristics or combination thereof, having clean, hard, durable, uncoated particles free from deleterious matter.

Deleterious substances shall not be present in the aggregate in excess of the following limits:

MATERIAL	PERCENT (by weight)
Soft fragments	2.00
Coal and lignite	0.30
Clay lumps	0.25
Material passing No. 200 sieve	1.00
Other deleterious substances such as shale, alkali, mica, coated grains, soft and flaky particles, etc.	3.00

The sum of the percentages of all deleterious substances in any size or delivered to the mixer, shall not exceed five percent by weight.

Coarse aggregate may be rejected if it fails to meet the following test requirements:

(a) Los Angeles Abrasion Test: If the percent of loss by weight exceeds 10% at 100 revolutions, or 40% at 500 revolutions.

(b) Sodium Sulfate Test for Soundness: If the weighted average loss after five cycles

is more than 20% by weight.

(c) Gradation: Coarse aggregate shall be graded by weight as follows:

SIEVE SIZE	PERCENT PASSING (by weight)
1 inch	100
3/4 inch	90-100
3/8 inch	20-55
No. 4	0-10
No. 8	0-5

The maximum size of the aggregate shall be not larger than one-fifth of the narrowest dimension between forms within which the concrete is to be incased, and in no case not larger than three-fourths of the minimum clear spacing between reinforcing bars or between reinforcing bars and forms. For un-reinforced concrete slabs the maximum size of aggregates shall not be larger than one-fourth the slab thickness.

5.2(c) WATER: Sufficient potable water shall be added to the mix to produce concrete with the minimum practical slump, and in no case shall the slump be greater than that shown in Table 5.1.

The maximum permissible water-cement ration (including free moisture on the aggregate) shall be 5 gallons per bag of cement (0.44) for Class A and 5 3/4 gallons per bag of cement (0.51) for Class C concrete.

5.2(d) ENTRAINING AGENT: An air-entraining agent shall be used in all concrete exposed to the weather. The agent shall conform to ASTM designation C 260. Air content for air-entrained concrete shall be 5% by volume (plus or minus 1%). The air-entraining agent shall be added as a liquid to the mixing water by means of mechanical equipment capable of accurate measurement and control.

5.3(e) ADMIXTURES:

(1) Pozzolan: If authorized by the County Engineer, pozzolan conforming to the requirements of ASTM C 618 Class N may be added to the concrete mix with no reduction in cement.

Pozzolans shall be sampled and tested as prescribed in ASTM C 618 and ASTM C 311. The contractor shall obtain and deliver to the County Engineer a certification of compliance signed by the Pozzolan supplier identifying the Pozzolan and stating that the Pozzolan delivered to the batching site complies with applicable specifications.

Pozzolan material shall be handled and stored in the same manner as Portland cement. When facilities for handling bulk Pozzolan are not available, the Pozzolan shall be delivered in original unopened sacks bearing the same name and brand of supplier, the type and source of the Pozzolan, and the weight contained in each sack plainly marked thereon.

Different brands or types of pozzolan shall not be mixed together unless written permission has first been obtained from the County Engineer. All pozzolan used in the manufacture of concrete for any individual structure shall be of the same type, and from the same source unless otherwise approved by the County Engineer.

(2) Calcium-Chloride: No calcium chloride shall be added to any concrete mix. Non-chloride accelerators may be used with permission of the County Engineer.

(3) Water Reducing Agents: Both regular and high range water reducing agents (super-plasticizers) complying with ASTM Specification C 494, Types "A", "D", "F", and "G" may be added to the concrete to improve its workability and to reduce the water/cement ratio. The amount of water reducing agent added shall be no greater than 1.5 pounds per cubic yard of concrete. Table 5.1 lists the maximum slumps allowable for the different types of reducing agents.

**TABLE 5.1
REDUCING AGENTS**

MIXING CONDITIONS		MAXIMUM SLUMP
No water reducers		3"
WITH WATER REDUCERS	Winter: C494 Type "A" (normal set)	4"
	Summer: C494 Type "D" (retarded set) Max. retardation 2 hours	4"
	Winter: C494 Type "F" (normal set)	7"
WITH HIGH RANGE WATER REDUCER	Summer: C494 Type "G" (retarded set)	7"

5.3 CONCRETE MIX: For the purpose of practical identification concrete has been divided into classes. The basic requirements of Class A and Class C and the use for each is defined below:

	MINIMUM CEMENT CONTENT	MINIMUM CEMENT CONTENT	MAXIMUM WATER CONTENT	MINIMUM 28-DAY COMP. STRENGTH	PRIMARY USE
CLASS	(bags/ C.Y.)	(pounds/ C.Y.)	(gal/bag of cement)	(psi)	
A	6	564	5	4,000	Reinforced structural concrete; side- walks; curbs & gutters; cross gutters; pave- ments; unrein- forced footings
C	5	470	5.75	3,000	Minor non- structural items such as thrust blocks; anchors; mass concrete, etc.

Unless specifically waived by the County Engineer, all concrete placed shall be Class "A", six-bag mix and the minimum allowable compressive strength of concrete at the age of 28 days shall be 4000 p.s.i. Strengths shall be determined in accordance with current ASTM C 39 and C 31.

5.4 CONSTRUCTION STANDARDS:

5.4(a) FORMS: Forms shall be substantially built and adequately braced so as to withstand the liquid weight of concrete. All linings, studding, walling and bracing shall be such as to prevent bulging, spreading, or loss of true alignment while pouring and displacement of concrete while setting.

5.4(b) PREPARATIONS: Before batching and placing concrete, all equipment for mixing and transporting the concrete shall be cleaned, all debris and ice shall be removed from the places to be occupied by the concrete, forms shall be oiled with a form-release agent, and masonry filler units that will be in contact with concrete shall be well drenched with water (except in freezing weather), and the reinforcement shall be thoroughly cleaned of ice or other coatings. Water shall be removed from spaces to receive concrete.

SECTION 6

REINFORCING STEEL

6.1 GENERAL: This section of the specification defines the materials, design, and construction standards for the use of reinforcing steel in concrete construction.

6.2 MATERIALS: All bar material used for reinforcement of concrete shall be intermediate or hard grade steel conforming to the requirements of ASTM Designation A 615 and shall be deformed in accordance with ASTM Designation A 615. All reinforcing steel shall be minimum grade 60 unless approved otherwise the County Engineer.

Reinforcing steel bars shall conform to the requirements of ASTM A 615, and the specifications for Billet-Steel Bars for Concrete Reinforcement ASTM A 615, or the specification for rail-steel concrete reinforcement bars, ASTM A 616. All bars shall be deformed either round or square and have a net section equivalent to that of plain bar of equal nominal size. Only intermediate and/or hard grades will be used and no twisted bars will be accepted.

All reinforcing steel, at the time concrete is placed, shall be free from flaws, cracks, mill scale, rust, oil, dirt, paint, or other coatings that will destroy or reduce the bond.

6.3 CONSTRUCTION STANDARDS:

6.3(a) BENDING: Reinforcing bars shall be accurately formed to the dimensions indicated on the Plans. Bends for stirrups and ties shall be made around a pin having a diameter not less than two times the minimum thickness of the bar. Bends for other bars shall be made around a pin having a diameter not less than six times the minimum thickness of the bar, except that for bars larger than one inch, the pin shall be not less than eight times the minimum thickness of the bar.

6.3(b) SPLICING: Splicing of bars at points other than as shown on the Plans will be permitted only by permission of the Engineer. Splices of reinforcement at points of maximum stress shall be avoided wherever possible, and shall be staggered when used. The minimum overlap for a lapped splice shall be 24 bar diameters, but not less than 12 inches.

6.3(c) PLACING: All reinforcing bars shall be placed accurately in the position shown on the Plans and shall be securely held in position by annealed iron wire ties of not less than 16 gauge or suitable clips at intersection and supported by metal supports, spacers or hangers, in such a manner that there will not be any displacement while placing concrete.

6.3(d) EMBEDMENT AND PROTECTION: All reinforcing steel shall be protected by concrete embedment and protective cover as shown in Table 6.1, such cover in each case being the shortest distance between the face of the form or concrete surface, and the nearest edge or face of the reinforcement.

When placing concrete on earth surfaces, the surfaces shall be free from frost, ice, mud and water. When the sub-grade is dry soil or previous material, it shall be sprayed with water prior to the placing of concrete or shall be covered with water-proof sheathing paper or a plastic membrane. No concrete shall be placed until the surfaces have been inspected and approved by the County Engineer or his authorized representative.

5.4(c) CONCRETE MIXING: The concrete shall be mixed until there is a uniform distribution of the materials. Sufficient water shall be used in concrete in which reinforcement is to be imbedded to produce a mixture which will flow sluggishly when worked and which, at the same time, can be conveyed from the mixer to the forms without separation of the coarse aggregate from the mortar. In no case shall the quantity of water used be sufficient to cause the collection of a surplus in the forms.

Ready-mixed concrete shall be mixed and delivered in accordance with the requirements set forth in Specifications for Ready-Mixed Concrete (ASTM C94). Concrete shall be delivered and deposited in its final position within 90 minutes after adding the cement and water to the mixture.

5.4(d) DEPOSITING: Concrete shall be deposited as nearly as practical in its final position to avoid segregation due to rehandling or flowing. The concrete placing shall be carried on at such a rate that the concrete is at all times plastic and flows readily into the corners of forms and reinforcing bars. No concrete that has partially hardened or been contaminated by foreign material shall be deposited in the work, nor shall re-tempered concrete be used.

All concrete in structures shall be compacted by means of high-frequency internal vibrators of approved type and design during the operation of placing and shall be thoroughly worked around reinforcement and embedded fixtures and into the corners of the forms.

5.4(e) PLACING CONCRETE IN COLD WEATHER: No concrete shall be poured where the air temperature is lower than 35° F. unless approved by the County Engineer. When there is likelihood of freezing during the curing period, the concrete shall be protected by means of an insulating covering to prevent freezing of the concrete, for a period of not less than seven days after placing. Equipment for protecting the concrete from freezing shall be available at the job site prior to placing concrete. Particular care shall be exercised to protect edges and exposed corners from freezing.

5.4(f) FINISHING: After the concrete for slab has been brought to the established grade and screeded, it shall be worked with a magnesium float and then given a light "broom" finish. In no case shall dry cement or a mixture of dry cement and sand be sprinkled on the surface to absorb moisture or hasten hardening. Surface edges of all slabs shall be rounded to a radius of 1/4 to 1/2 inch with standard concrete finishing tools.

5.4(g) CURING AND PROTECTION: As soon as the concrete has hardened sufficiently to prevent damage, the finished surface shall be kept moist for seven days or a chemical curing agent

may be used to prevent the concrete from premature drying.

The freshly finished surface shall be protected from hot sun and drying winds until it can be sprinkled or covered as above specified. The concrete surface must not be damaged or pitted by rain. The contractor shall provide and use, when necessary, sufficient tarpaulins to completely cover all sections that have been placed within the preceding 12 hours. The contractor shall erect and maintain suitable barriers to protect the finished surface. Any section damaged from traffic, weather or other causes occurring prior to its official acceptance, shall be repaired or replaced by the contractor in a manner satisfactory to the County Engineer.

5.5 QUALITY CONTROL: The average of any three consecutive strength breaks shall equal or exceed the minimum 28 day compressive strength. If the average of any three consecutive breaks is below specification, the concrete may be accepted at a reduced price, unless retests prove otherwise. The price reduction shall apply to the amount of concrete represented by the strength test in accordance with Table 5.2.

**TABLE 5.2
ACCEPTANCE SCHEDULE FOR CONCRETE**

P.S.I. BELOW SPECIFIED STRENGTH SPECIFICATION	PAY FACTOR
1-100	98%
101-200	94%
201-300	88%
301-400	80%

Concrete with a compressive strength of more than 400 psi below the required strength shall be evaluated by the County Engineer for capabilities necessary to the integrity of the structure. The County Engineer may accept this concrete at a pay factor of 80%, or require that it be replaced with acceptable material. The County Engineer shall make the final decision. If additional tests are required to determine if strength tests are representative they shall be performed by coring in accordance with ASTM C 823 method or other acceptable non-destructive methods. The re-tested strength shall be the average of three cores (or other means). All costs incurred in re-sampling and re-testing shall be paid by the owner if the re-tested strength is below standard, and shall be assumed by the County if the re-tested strength is above standard.

For subdivision construction, the owner shall be responsible for providing the required testing from an independent testing laboratory. For all concrete that is sub-standard, the owner shall pay a penalty to the County (to defray increased maintenance costs) equal to the reduction in payment outlined in Table 5.2.

TABLE 6.1
REINFORCING BAR CLEARANCE

LOCATION OF REINFORCEMENT	COVER
Bottom bars- where concrete is deposited against ground without use of forms.	Not less than 3"
Main bars - where concrete is exposed to the weather, or exposed to the ground but placed in forms.	Not less than 2"
Bars in slabs and walls not exposed to the ground or weather	Not less than 1"

6.4 WIRE OR WIRE MESH REINFORCEMENT: Welded wire fabric for concrete reinforcement shall conform to the requirement of ASTM A 185. Wire for concrete reinforcement shall conform to the requirements of the "Standard Specification for Cold Drawn Steel Wire for Concrete Reinforcement" ASTM A 82. All wire reinforcement, wire mesh, or expanded metal shall be of the type designated unless an alternate type is approved by the Engineer.

Polypropylene fibers may be used in lieu of wire mesh when it is determined by the Engineer that the wire mesh is not used as structural reinforcement.

6.5 STEEL FIBER REINFORCEMENT: Deformed steel fiber for concrete reinforcement shall conform to the requirements of ASTM A 820, Type I, deformed fiber, except that the average tensile strength shall be not less than 150,000 psi.

6.6 SYNTHETIC REINFORCING FIBERS:

6.6(a) ENGINEERED SYNTHETIC REINFORCING FIBERS: Engineered synthetic reinforcing fibers shall be 100% Polypropylene collated, fibrillated fibers. Fiber length and amount per manufacturer's recommendations shall correspond with the concrete mixture. The fiber manufacturer or approved distributor shall provide the services of a qualified technician for the pre-construction meeting and initial job start up.

Physical properties of the fibers shall be as follows:

Specific gravity	0.91
Modulus of elasticity	500,000 to 700,000 psi
Tensile strength	70,000 to 110,000 psi
Length	0.25 to 2.50 inches

The fiber manufacturer shall certify that all polypropylene fibers meet the physical properties, and are specifically manufactured for use in concrete from virgin polypropylene, containing no reprocessed olefin materials. If the fiber manufacturer is other than the brand name listed on the literature and packaging, the certification must be from the original manufacturer of the fibers.

6.6(b) EXECUTION: Fiber-mesh shall be added only at the concrete batch plant to assure uniform and complete dispersion of the collated-fibrillated fiber bundles into single mono-filaments within the concrete.

SECTION 7

CURB, GUTTER, AND SIDEWALK

7.1 GENERAL: This section of the specifications defines materials, practices and designs to be used in the construction of all public curb, gutter, and sidewalk within the unincorporated County.

Curb and gutter type HB30-7 shall be used on any local, arterial or collector street except where irrigation water will be carried in the curb, in which case HB30-8 curb and gutter shall be used.

All curb, gutter and sidewalk shall consist of air-entrained, type V Portland Cement Concrete constructed on a prepared conform to the lines and grades, thickness, and typical cross sections shown on the plans or established by the Engineer.

Concrete to be used shall conform to the specification outlined in Section 5 "Portland Cement Concrete" of these specification. Certified copies, in triplicate, of the mill test of cement shall be furnished to the County upon request of the County Engineer.

The contractor shall be responsible for stamping an "S" in the curb face at all sewer lateral locations and a "W" in the curb face at all water lateral locations along the curb.

Minimum curb and gutter grade shall be 0.5% (0.5 foot elevation difference in 100 feet of curb length).

7.2 SUB-GRADE: The sub-grade shall be excavated or filled with suitable material (group classifications A-1, A-2, A-3, or A-4 as shown in table 3.1 in Section 3 of these specifications) to within six inches of the required grades for curbs and gutters, waterways and driveways, and to within four inches of the required grades for sidewalks. All soft, yielding, and otherwise unsuitable material shall be removed and replaced with suitable materials as outlined above. Filled sections shall be compacted and extend to a minimum of one foot outside the form lines. The sub-grade shall be compacted to a minimum of 95% dry density, be trimmed to a uniform smooth surface, and be in a moist (but not saturated) condition when the concrete is placed.

A gravel base course consisting of 1" maximum crushed road base gravel six inches thick shall be placed under all curbs, gutters, driveways and waterways and four inches thick under all sidewalks. Where the foundation material is found to be unstable, the contractor shall furnish and place sufficient extra gravel fill as directed by the County Engineer to firm up the soil upon which the curb and gutter is to be placed.

7.3 CONSTRUCTION STANDARDS:

7.3(a) CONCRETE PLACEMENT: The concrete shall be placed either by an approved slip form/extrusion machine, by the formed method, or by a combination of those methods.

(1) Machine Placement: The slip form/extrusion machine approved shall be so designed as to place, spread, consolidate, screed, and finish the concrete in one complete pass in such a manner that a minimum of hand finishing will be necessary to provide a dense and homogeneous concrete section. The machine shall shape, vibrate, and/or extrude the concrete for the full width and depth of the concrete section being placed. It shall be operated with as nearly a continuous forward movement as possible. All operations of mixing, delivery, and spreading concrete shall be so coordinated as to provide uniform progress, with stopping and starting of the machine held to a minimum.

(2) Formed Method: The forms shall be of wood, metal, or other suitable material that is straight and free from warp, having sufficient strength to resist the pressure of the concrete without displacement and sufficient tightness to prevent the leakage of mortar. Flexible or rigid forms of proper curvature may be used for curves having a radius of 100 feet or less. Division plates shall be metal.

The front and back forms shall extend for the full depth of the concrete. All forms shall be braced and staked so that they remain in both horizontal and vertical alignment until their removal. They shall be cleaned and coated with an approved form-release agent before concrete is placed against them.

The concrete shall be deposited into the forms without segregation and then tamped and spaded or mechanically vibrated for thorough consolidation. Front and back forms shall be removed without damage to the concrete after it has set.

7.3(b) FINISHING: The plastic concrete shall be finished smooth, if necessary, by means of a wood or magnesium float and then given a final surface texture using a light broom or burlap drag. Concrete that is adjacent to forms and formed joints shall be edged with a standard jointer or edging tool to the dimensions shown on the plans. The top, face, and flow-line of the curb and also the top of the apron on driveway aprons shall be finished true to line and grade and without any irregularities of surface noticeable to the eye.

The gutter shall not pond water when tested by water flow and no portion of the surface of the curb and gutter shall depart more than one-fourth of an inch from a straight edge, ten feet in length, placed on the curb parallel to the center line of the street nor shall any part of the exposed surface present a wavy appearance.

7.3(c) JOINTING:

(1) Contraction Joints: Transverse weakened-plane contraction joints shall be constructed at right angles to the curb line at intervals not exceeding 12 feet for curb and gutter and not to exceed the sidewalk width for sidewalks. Joint depth shall at least be one-half of the cross section of the concrete. Generally, surface areas shall not exceed 50 square feet without contraction joints.

Contraction joints may be sawed, hand-formed, or made by placing one-eighth inch thick division plates in the form-work. Sawing shall be done within 24 hours after the concrete has set to prevent the formation of uncontrolled cracking. The joints may be hand-formed either by using a narrow or triangular jointing tool or a thin metal blade to impress a plane of weakness into the plastic concrete, or by inserting one-eighth inch thick steel strips into the plastic concrete temporarily. Steel strips shall be withdrawn before final finishing of the concrete. Where division plates are used to make contraction joints, the plates shall be removed after the concrete has set while the forms are still in place.

(2) Expansion Joints: Expansion joints shall be constructed at right angles to the curb line at no greater than 450 foot intervals for curb and gutter, at immovable structures and at points of curvature for short-radius curves. Spacing for sidewalk jointing shall not exceed 20 feet. Filler material for expansion joints shall conform to the requirement of ASTM D 994, D 1751, or D 1752 and shall be furnished in a single 1/2 inch thick piece for the full depth and width of the joint.

Expansion joints in a slip formed curb and gutter shall be constructed with an appropriate hand tool by raking or sawing through partially set concrete for the full depth and width of the section. The cut shall be only wide enough to permit a snug fit for the joint filler. After the filler is placed, open areas adjacent to the filler shall be filled with concrete and then troweled and edged.

Alternately, an expansion joint may be installed by removing a short section of freshly extruded curb and gutter, immediately installing temporary holding forms, placing the expansion joint filler, and replacing and reconsolidating the concrete that was removed. Contaminated concrete shall be discarded.

(3) Other Jointing: Construction joints may be either butt or expansion-type joints. Curbs and gutters constructed adjacent to existing concrete, shall have the same type of joints as in the existing concrete with similar spacing, however, contraction joint spacing shall not exceed 12 feet.

A silicone joint sealer, as defined in ASTM C 962, shall be applied to all form-plate expansion joints. The silicone joint sealer shall be applied under pressure to a depth of not less than two inches from the outside surface of the curb and gutter.

7.3(d) PROTECTION: At all times during the construction of the project, the contractor shall have materials available at the site to protect the surface of the plastic concrete against rain. These materials shall consist of waterproof paper or plastic sheeting. For slip-form construction, materials such as wood planks or forms to protect the edges shall also be required.

When concrete is being placed in cold weather and the temperature may be expected to drop below 35° F., suitable protection shall be provided to keep the concrete from freezing until it is at least 10

days old. Concrete injured by frost action shall be removed and replaced at the contractor's expense.

7.3(e) CURING: Concrete shall be cured for at least three days after placement to protect it against loss of moisture, rapid temperature change and mechanical injury. Moist burlap, waterproof paper, polyethylene sheeting, liquid membrane curing compound or a combination thereof may be used as curing material. Membrane curing shall not be permitted in frost-affected areas when the concrete will be exposed to deicing chemicals within 30 days after completion of the curing period.

7.3(f) BACKFILLING: After the forms have been removed from the curb and gutter, the Contractor shall backfill to at least the property line paralleling the curb and to the elevation of the finished concrete and shall backfill from the lip of the gutter to the edge of the existing asphalt surface, as required by the County Engineer.

7.4 CONCRETE REPAIR: In lieu of removing and replacing concrete with minor cracks, the County Engineer may direct the Contractor to repair the affected sections by sawing, cleaning and sealing the cracks. All cracks repaired shall be sealed with a polyurethane TTS-230 type II crack filler or an approved silicone type crack filler. Where modifications are to be made to existing concrete, the edges to be poured against shall be sawed and the new concrete shall be edged with a standard edging tool.

7.5 DRIVEWAY CURBS (CURB CUTS):

(I) Method I consists of removing the curb and gutter and replacing it with a driveway curb conforming to required standards. Care must be taken during the removal process to avoid damaging the asphalt near the lip of the gutter. If the asphalt is damaged, an additional strip of asphalt, generally 1' in width beyond the lip of the curb must be saw cut, removed and replaced. Care must also be taken to ensure that the lip at the new driveway curb is not above the edge of the asphalt.

(II) Method II consists of cutting off the back of the existing curb to conform to the current design configuration and then grinding the edges to provide a smooth, rounded surface. This procedure is available through concrete cutting companies.

SECTION 8

PIPELINE CONSTRUCTION

8.1 GENERAL: This section covers the requirements for trenching, placement and backfilling of underground pipelines and incorporates the requirements of the AWWA Standards, Manufacturers Recommended Installation Procedures or the following, whichever is more stringent. Backfill shall include filling of all trenches to the original ground surface or final grading elevation as shown on the drawings or otherwise directed by the appropriate county departments.

8.2 CONTROL OF GROUND WATER: All trenches shall be kept free from water during excavation, fine grading, pipe laying, jointing and embedment operations. Where the trench bottom is mucky or otherwise unstable because of the presence of ground water and in cases where the static ground water elevation is above the bottom of any trench or bell hole excavation such ground water shall be lowered to the extent necessary to keep the trench free from water and the trench bottom stable when the work within the trench is in progress. Surface water shall be prevented from entering the trenches.

8.3 EXCAVATION FOR PIPELINES: Trench excavation shall include all operations necessary for excavation of all materials of whatever nature falling within the designated lines of the trenches. Trenches shall be excavated to the lines shown on the drawings or otherwise established by the Engineer and to a depth so as to provide a minimum burial of three feet over the pipe unless otherwise specified. The bottom two feet of the trench walls shall be vertical. All finish grade excavation necessary for preparation of the trench bottom shall be made manually. No over-excavating shall be allowed without re-compaction of backfill in accordance with these Specifications.

Excavation for trenches in ledge rock, cobble rock or stones shall extend to a depth of at least four inches below the invert of the pipe. Bedding material as outlined in table 8.1 shall be placed and compacted to 95% of maximum dry density with pneumatic or vibratory tampers in six-inch lifts to provide a smooth, well compacted and stable foundation for the pipe or appurtenant works.

Trench bottoms shall be hand-shaped as specified and the maximum width of the trench, measured at the top of the pipe, shall be as narrow as possible, but not wider than 15 inches on each side of the pipe.

Where unstable earth, mud or muck is encountered in the excavation at the grade of the pipe, the unsuitable material shall be removed to a minimum of 12-inches below grade and the subsequent hole be backfilled with crushed rock or gravel (as called out in table 8.1 under "foundation material") to provide a stable sub-grade. The gravel material shall be deposited over the entire trench width in a maximum of six-inch thick layers. Each layer shall be compacted by tamping, rolling, vibrating, spading, slicing, rodding or by a combination of one or more of these methods. In addition, the

shoulders and other areas, the in-place density shall be a minimum of 90% of the maximum dry density. Compaction tests on all trenches shall be made in conformance with the latest revision of ASTM standards.

8.7(a) INITIAL BACKFILL PROCEDURE: Backfill of selected material which shall conform to the requirements of Table 8.1 shall be placed carefully in eight inch non-compacted horizontal layers and tamped to a depth of 8 to 12 inches over the top of the pipe. During compaction of the initial backfill, special care shall be taken so as to not move the pipe, either vertically or horizontally. All backfill operations shall be performed in such a manner so as to avoid any damage to the pipe, valves, laterals, etc. In the event such damage or displacement occurs, such damaged or displaced pipe shall be removed and replaced with undamaged pipe on proper grade and alignment.

8.7(b) FINAL BACKFILL PROCEDURE: The backfill above a point 8 to 12 inches above the top of the pipe, shall be backfilled in horizontal layers 12 inches thick or less with materials containing no brush, perishable or objectionable material, or rocks, stones or boulders larger than 8 inches in the greatest dimension. The material shall be mechanically compacted with appropriate vibrating compaction equipment or consolidated thoroughly by puddling with hose and long pipe nozzle or by flooding the trench. Wherever, in the opinion of the County Engineer, surface settlement is not important, consolidation or compaction may be omitted and the backfill shall be neatly rounded over the trench to a sufficient height to allow for settlement to grade after consolidation.

8.7(c) COMPACTION OF BACKFILL: The backfill shall be thoroughly compacted by consolidation or mechanical compaction in accordance with the following methods:

(1) Consolidation: Consolidation of sandy material (Group classifications A-1, A-2, and A-3 shall be accomplished by saturating the material and rodding it by hand with a hose, pole or rod, or by driving rubber tired equipment over it while saturated.

The water shall be allowed to flow slowly into the trench and shall be worked down to the bottom of the trench by "poling". Poling is accomplished by forcing a pole and moving it around to let the water flow down through the backfill to the level of the pipe and moving it around to let the water flow down the hole. The channel made by the pole shall be kept open until the water running down it has settled the backfill. After the water-settled trench has set for several days, any depression in the trench shall be filled, mounded over and wheel rolled to compact the material thus placed.

All precautions necessary shall be taken by the Contractor to prevent damage and movement (including floating) of the pipeline, structures, existing adjacent improvements and utilities. The allowance of the use of consolidation methods shall not guaranty or imply that the use of such methods will not result in damage to adjacent ground. The Contractor shall make his own determination in this regard, and shall assume all risks and liability for settlement or movement of adjacent ground, improvements, or utilities, either on the surface of the ground

material shall be graded to produce a uniform and continuous support for the entire length of the installed pipe

**TABLE 8.1
BACKFILL MATERIALS**

PERCENT PASSING FOR:				
SIEVE SIZE	FOUNDATION MATERIAL*	BEDDING MATERIAL	INITIAL BACKFILL MATERIAL	FINAL BACKFILL MATERIAL
2 inch	100	----	----	Native material which contains
3/4 inch	5 - 15	-----	100	no sod, vegetation, rocks larger
No. 4	0 - 5	100	40 - 70	than 8" in diameter, asphalt
No. 50	----	5 - 15	20 - 50	or concrete chunks, etc.
No. 100	----	0 - 5	5 - 30	

* To be used only when the trench bottom is unstable.

(Drawing No. U-02 in the Appendix shows the typical trench backfill detail including backfill nomenclature.)

8.4 SHEETING, BRACING AND SHORING OF EXCAVATIONS: All excavations shall be sheeted, braced and shored as required to protect the workmen and existing utilities and improvements from sliding sloughing or settling of the trench walls while the work is in progress. All such sheeting, bracing and shoring shall comply with the requirements of the Utah State Industrial Commission. All damage resulting from lack of adequate sheeting, bracing and shoring shall be the responsibility of the Contractor and the Contractor shall effect all necessary repairs or reconstruction resulting from such damage.

8.5 BLASTING: The Contractor shall comply with all laws, ordinances and applicable safety code requirements and regulations relative to the handling, storage and use of explosives and protection of life and property.

The Contractor shall comply with the provisions outlined in the U.S. Bureau of Mines Bulletin No.

to receive the bottom quadrant of the pipe. Before preparing the groove, the trench bottom shall be excavated or filled and compacted to an elevation sufficiently above the grade of the pipe so that, when completed, the pipe will be true to line and grade. Bell holes shall be excavated so that only the barrel of the pipe receives bearing from the trench bottom. Large rocks (over 6 inches in least dimension) near the surface shall be removed and the hole refilled with approved backfill in accordance with Table 8.1.

Sewer and drain pipe shall be laid up grade. All pipe installation shall proceed with joints closely and accurately fitted. Gaskets shall be fitted properly in place and care shall be taken in joining the units to avoid twisting the gaskets. Joints shall be clean and dry and a joint lubricant, as recommended by the pipe supplier, shall be applied uniformly to the mating joint surfaces to facilitate easy and positive joint closures. If adjustments to the position of a pipe length is required after being laid, the pipe shall be removed and rejoined as for a new pipe. When laying is not in progress, the ends of the pipe shall be closed with a tight fitting stopper to prevent the entrance of foreign material. In addition to the above requirements all pipe installation shall comply to the specified requirements of the pipe manufacturer.

8.6(c) PIPE BEDDING: Pipe shall be protected from lateral displacement and possible damage resulting from impact or unbalanced loading during backfilling operations by being adequately bedded in accordance with the bedding details in the appendix of these specifications.

Pipe bedding materials shall be deposited and compacted in layers not to exceed six inches in compacted thickness. Deposition and compaction of bedding materials shall be done simultaneously and uniformly on both sides of the pipe. Compaction shall be accomplished with hand or mechanical compactors. All bedding materials shall be placed in the trench with hand tools or other approved methods in such a manner that the bedding materials will be scattered alongside the pipe and not dropped into the trench in compact masses. Bedding materials shall conform to the requirements of Table 8.1 of these specifications and shall be free from roots, sod, or other vegetable matter.

In the event trench materials are not satisfactory for pipe bedding, imported bedding will be required. Imported bedding shall consist of placing compacted granular material on each side of and to the level of twelve inches above the top of the pipe. Imported bedding material shall be graded in accordance with Table 8.1, under "bedding materials".

8.7 BACKFILLING: Backfill shall be carefully placed around and over pipes and shall not be permitted to fall directly on a pipe from such a height, or in such a manner as to cause damage. Backfill material shall be as required by Table 8.1 or as approved by the County Engineer and shall not contain any wood, grass, roots, broken concrete, asphalt chunks, trash or debris of any kind that may cause unequal settlement or improper consolidation.

The backfill in all utility trenches shall be either compacted or consolidated according to the requirements of the materials being placed. Under pavements, or other surface improvements, the in-place density shall be a minimum of 95% of laboratory standard maximum dry density. In

shoulders and other areas, the in-place density shall be a minimum of 90% of the maximum dry density. Compaction tests on all trenches shall be made in conformance with the latest revision of ASTM standards.

8.7(a) INITIAL BACKFILL PROCEDURE: Backfill of selected material which shall conform to the requirements of Table 8.1 shall be placed carefully in eight inch non-compacted horizontal layers and tamped to a depth of 8 to 12 inches over the top of the pipe. During compaction of the initial backfill, special care shall be taken so as to not move the pipe, either vertically or horizontally. All backfill operations shall be performed in such a manner so as to avoid any damage to the pipe, valves, laterals, etc. In the event such damage or displacement occurs, such damaged or displaced pipe shall be removed and replaced with undamaged pipe on proper grade and alignment.

8.7(b) FINAL BACKFILL PROCEDURE: The backfill above a point 8 to 12 inches above the top of the pipe, shall be backfilled in horizontal layers 12 inches thick or less with materials containing no brush, perishable or objectionable material, or rocks, stones or boulders larger than 8 inches in the greatest dimension. The material shall be mechanically compacted with appropriate vibrating compaction equipment or consolidated thoroughly by puddling with hose and long pipe nozzle or by flooding the trench. Wherever, in the opinion of the County Engineer, surface settlement is not important, consolidation or compaction may be omitted and the backfill shall be neatly rounded over the trench to a sufficient height to allow for settlement to grade after consolidation.

8.7(c) COMPACTION OF BACKFILL: The backfill shall be thoroughly compacted by consolidation or mechanical compaction in accordance with the following methods:

(1) Consolidation: Consolidation of sandy material (Group classifications A-1, A-2, and A-3 shall be accomplished by saturating the material and rodding it by hand with a hose, pole or rod, or by driving rubber tired equipment over it while saturated.

The water shall be allowed to flow slowly into the trench and shall be worked down to the bottom of the trench by "poling". Poling is accomplished by forcing a pole and moving it around to let the water flow down through the backfill to the level of the pipe and moving it around to let the water flow down the hole. The channel made by the pole shall be kept open until the water running down it has settled the backfill. After the water-settled trench has set for several days, any depression in the trench shall be filled, mounded over and wheel rolled to compact the material thus placed.

All precautions necessary shall be taken by the Contractor to prevent damage and movement (including floating) of the pipeline, structures, existing adjacent improvements and utilities. The allowance of the use of consolidation methods shall not guaranty or imply that the use of such methods will not result in damage to adjacent ground. The Contractor shall make his own determination in this regard, and shall assume all risks and liability for settlement or movement of adjacent ground, improvements, or utilities, either on the surface of the ground

or underground.

For trenches less than ten feet deep, the backfill may be consolidated in one lift. For depths greater than ten feet, the backfill shall be consolidated in lifts of ten feet or less, unless otherwise directed by the County Engineer. Where the trench settlement is inadequate from consolidation, the Contractor shall use mechanical means as described below to obtain maximum settlement.

(2) Mechanical Compaction: Structural and trench backfill shall be deposited in horizontal layers and compacted by the following method in such manner that the compacted material will be homogeneous and free from lenses, pockets, streaks, and other imperfections.

The materials shall be deposited in horizontal layers (across the length or width of the excavation) of not more than six inches compacted thickness. The excavation and placing operations shall be such that the materials, when compacted, will be blended sufficiently to secure the best practicable degree of compaction, impermeability and stability.

Prior to and during compaction operations, all backfill material shall have the optimum practicable moisture content and shall be uniform throughout each layer.

Moistening of the materials shall be performed at the site of excavation. If the moisture content is not optimum for compaction, the compaction operations shall be delayed until such time as the material has been brought the optimum moisture content. When the material has been properly conditioned, it shall be compacted in by using appropriate mechanical compaction equipment as indicated below.

(a) Vibrating Rollers shall consist of a self-propelled roller with a vibrating steel drum of at least one ton capacity. The roller shall have an effective rolling width of at least 24 inches and shall deliver a compaction force of at least 700 pounds per square inch when vibrating.

(b) Pneumatic rollers shall consist of a self-propelled roller with pneumatic tires arranged in a manner so as to provide a satisfactory compacting unit. The roller shall have an effective rolling width of at least 30 inches and shall give a compaction force of at least 500 pounds per inch of width of tread when fully loaded. The tires shall be uniformly inflated.

(c) Vibrating plates shall consist of a pneumatic vibrating plate attached to the boom of a backhoe and capable of compacting an area of at least three square feet. The plate and backhoe combination shall together be capable of exerting a compactive force of at least 1,000 pounds per square inch.

(d) Hand Compactors shall be used when hand compacted methods are specified or

required because the location of the area to be compacted does not permit the use of self-propelled mechanical compactors. Vibrating plates, "pogo stick" tampers or other approved hand compacting equipment shall be used.

8.8 TRENCHES ON HIGHWAYS AND STREETS: Wherever trenches will be in, or must cross State highways or streets, the contractor shall obtain such excavation permits as are required for these crossings and shall become familiar with and abide by the rules and directions of the Utah Department of Transportation while working in these streets.

All contractors excavating in any County public right of way shall maintain a current bond in compliance with the County excavation ordinance and shall obtain an encroachment permit from the County prior to excavating.

All asphalt cuts shall be made with a diamond or carbide-tipped masonry or asphalt cutting saw or with a steel asphalt-cutting wheel attached to a grader or back-hoe. No scarifier-tooth cuts, back-hoe, bucket rips, or jackhammer space cuts will be allowed.

All backfilled trenches in roadways shall be patched with hot-mix asphalt within five days of initial excavation unless otherwise directed by the County Engineer.

All concrete or asphalt surfaces damaged or cut in trenching operations shall be restored to an as-good or better condition than prior to excavation in accordance with the provisions outlined in Section 13 of these specifications.

During the entire trenching, backfilling and patching operations, the contractor will be required to observe all safety and traffic control procedures as outlined in Section 1 of these specifications.

The contractor shall be responsible for maintenance of the trench and patch for a period of one year from the date of the completion of the patching operation.

Unless otherwise approved by the County Engineer, not more than 400 feet of trench shall be left unfilled at any time in one continuous run.

All streets and roads trenched shall be kept free from dust and open to through traffic unless permission to close the street is obtained by the contractor from the County Engineer. Up to one half the width of any street or road shall be temporarily restored for use before excavation is commenced on the remaining portion of the street or road. All excavation, backfilling and temporary resurfacing on any portion of any street or road shall be completed in one working day so that no trenches are left open over night.

SECTION 9

SEWER PIPE AND FITTINGS

9.1 GENERAL: This section specified acceptable pipe and accessories for public sanitary sewers, underground culverts, or storm drain construction within the Unincorporated County.

9.2 SEWER PIPE: Only those pipes listed below may be used in the construction of sanitary sewer lines in the Unincorporated County.

9.2(a) NON-REINFORCED CONCRETE SEWER PIPE: Non-reinforced concrete sewer pipe may be used for all sanitary sewers and storm drains up to and including 18 inch size unless otherwise specifically designated in these Specifications or on the approved Drawings. Pipe shall be extra strength pipe manufactured to comply with the requirements as set forth in ASTM Designation C 14, Class 3 unless otherwise approved by the County Engineer. Joints shall be of the bell and spigot with rubber gasket design and with joints and gaskets conforming to the requirements of ASTM Designation C 443. Pipe joints shall be so designed as to provide for self-centering and, when assembled, to compress the gasket to form a water tight seal. The gasket shall be confined in a groove on the spigot so that pipe movement or hydrostatic pressure will not displace the gasket.

9.2(b) REINFORCED CONCRETE SEWER PIPE: Reinforced Concrete Pipe shall be used for all sanitary sewers and storm drains greater than 18 inches in diameter, and for all sewers and drains of smaller size where installation does not provide a cover of at least three feet over the top of the pipe. Reinforced concrete pipe shall comply with the requirements of ASTM C 76 (Class II) unless otherwise approved by the County Engineer. Joints shall be of the bell and spigot design with rubber gasket type joints for sanitary sewers and storm drains, with an alternate option of tongue and groove mortar joints for storm drain lines.

9.2(c) P.V.C. PLASTIC SEWER PIPE: This Specification covers rigid polyvinyl chloride pipe and fittings, hereinafter called PVC fittings. PVC pipe and fittings from four inches to 15 inches in diameter shall meet or exceed all of the requirements of ASTM Specification D 3034. PVC pipe and fittings from 18 inches to 27 inches in diameter shall meet or exceed the requirements of ASTM F 679.

Each pipe used shall have a manufacturer's stamp on it indicating that it complies with the requirements of the appropriate specification. Any pipe not so stamped shall be rejected.

All pipe shall be homogeneous throughout and free from cracks, holes, foreign inclusions or other defects. All PVC sewer pipe shall be made from clean, virgin, Type 1, Grade 1, Polyvinyl Chloride conforming to ASTM Resin Specification D 1784.

All pipe joints shall be bell and spigot type with rubber ring gasket to permit expansion and

contraction. Pipe and fittings shall be assembled with non-toxic lubricant. Pipes of 4 inch and 6 inch diameter may be the solvent weld type. Pipe shall have the following minimum dimensions:

NOMINAL PIPE SIZE (INCHES)	OUTSIDE DIAMETER (INCHES)	MINIMUM WALL THICKNESS, (INCHES)
4	4.215	0.125
6	6.275	0.180
8	8.400	0.240
10	10.500	0.300
12	12.500	0.360

Spigot ends shall have a 15 degree tapered end with a memory mark around the diameter of the pipe to indicate proper insertion depth. Wyes shall be of the same material as the pipe, and in no case shall have thinner walls than that of the pipe furnished.

9.2(d) A.B.S. COMPOSITE AND SOLID WALL SEWER PIPE: This specification covers Acrylonitrile-Butadiene-Sturine (ABS) gravity sewer pipe. All ABS composite sewer pipe shall conform to the latest revision of ASTM Specification D 2680. The ABS material used shall be a virgin rigid plastic conforming to ASTM Specification D 1788 for rigid ABS plastics. The other component shall be Portland Cement, Perlite concrete or other inert filler material exhibiting the same degree of performance.

All solid wall ABS pipe shall conform to ASTM Specifications D 2751. Solid wall pipe used for laterals shall have a minimum wall thickness to diameter ratio of SDR-35. Fittings not described by these standards shall be shop fabricated or molded from materials listed in Paragraphs 4 and 5 of ASTM D 2680 and shall be of equivalent quality to those described.

All field joints shall be chemically welded. Primer, then cement shall be applied liberally to the outside of the spigot end and the inside of the coupling immediately prior to stabbing the pipe together. The pipe spigot end shall be supplied with home marks to assure proper jointing.

9.2(e) CLAY SEWER PIPE: All clay sewer pipe, specials, and fittings shall be of the best quality extra strength vitrified clay pipe conforming to the latest revision of ASTM Designation C 700. All pipe shall be of the bell and spigot type. Fittings and specials shall be manufactured in compliance with the ASTM designation shown above.

Joint seals shall be equal to but not restricted to "Wedge-Lock Joints" as manufactured by Utah Fire Clay. For plastic compression joints the entire bell and the barrel of pipe one inch behind the bell shall conform to extra strength clay pipe ASTM designation 278.

9.2(f) DUCTILE IRON SEWER PIPE: Ductile iron sewer pipe shall of 18/40 iron of thickness Class 22 (for pipe sizes 4" through 12") meeting the requirements of ASA Specifications

21.6 and shall have joints conforming to ASA A21.11 of the push-on rubber gasket type joints. All exterior surfaces of pipe and fittings shall be coated with hot coal tar as specified in the American Standard Specifications for Coal Tar Dip Coatings for Cast Iron Pipe and Fittings. All interior surfaces of pipe and fittings shall be coated with the Standard thickness of cement mortar lining in conformity with the requirements of ASA Standard A21.4.

Pipe and fittings shall be handled in such a manner as to insure installation in sound, undamaged condition. Particular care shall be taken not to injure the pipe coating and lining. Cement lining in pipe and fittings which has been broken or loosened shall be cause for rejection of the pipe or fittings. All damaged pipe coating shall be repaired or replaced prior to laying the pipe or placing the backfill. Repair shall be accomplished by removing all damaged coating, wire-brushing to exposed metal, and applying two coats of coal tar coating of a type and quality equal to that used originally in coating the pipe.

Cutting of pipe for closure pieces or for other reasons shall be done in a neat and workmanlike manner by a method which will not damage the pipe. Before installation, each pipe shall be inspected for defects and rung with a light hammer to detect cracks. All defective, damaged or unsound pipe shall be rejected.

9.3 STORM DRAIN PIPES: All pipes listed under Section 9.2 "Sanitary Sewer Pipes", of these specifications, as well as the following pipes, may be used in the construction of storm drain lines and culverts in the County.

9.3(a) POLYMERIC COATED CORRUGATED STEEL PIPE: Corrugated steel pipe shall meet the requirements of AASHTO Designation M-246, Type B, except that the thickness of the polymeric coating applied to both the inside and outside of the pipe shall be minimum of 0.010 inches. The polymeric coating shall be applied in the form of pre-formed sheets of the specified thickness. Materials used shall be only those specifically approved by these Specifications or the County Engineer.

9.3(b) CORRUGATED ALUMINUM PIPE: Corrugated aluminum alloy pipe shall conform to AASHTO Designation M-196.

Any aluminum alloy to be in contact with concrete shall first be spray or brush coated to a minimum depth of 0.05 inch with an asphalt-asbestos compound conforming to the requirements of Section 702 of the State of Utah Standard Specifications for Road and Bridge Construction. The aluminum alloy shall be thoroughly cleaned, including the removal of oil and grease, and shall be dry prior to treatment.

9.3(c) CORRUGATED POLYETHYLENE PIPE: Corrugated Polyethylene Pipe shall conform to the requirements of AASHTO Designation M-294.

9.4 SEWER MANHOLES: This section covers the requirements for the construction and

installation of sanitary sewer manholes. Manholes shall be water tight and be furnished complete with cast iron rings and covers.

9.4(a) CONCRETE BASES: Manhole bases shall be pre-cast or cast-in-place. The concrete shall conform to the requirements of Section 4 of these Specifications.

Where sewer lines pass through or enter manholes the invert channels shall be smooth and semi-circular in cross section. Changes of direction of flow within the manholes shall be made with a smooth curve with the longest radius possible. The depth of the channel in the manhole base shall be the full diameter of the sewer pipe being used at that manhole. The floor of the manhole outside the flow channels shall be smooth and slope toward the channel at not less than one-half inch per foot nor more than one-inch per foot.

9.4(b) WALL AND CONE SECTIONS: All manholes shall be constructed of either 48 inch or 60 inch inside diameter pre-cast, sectional, reinforced concrete pipe. Both cylindrical and taper sections shall conform to all requirements of ASTM Designation C 76 for Reinforced Concrete Culvert Pipe.

Throat sections of manholes shall be adjustable, by use of appropriate diameter pipe sections up to 18 inches in height.

The taper section shall be a maximum of three feet in height, shall be eccentric conical design, and shall taper uniformly from 48 or 60 inches to 30 inches inside diameter. Cones shall be set on the manhole sections so that the top opening of the cone is centered over the center line of the sewer.

60 inch inside diameter sewer manholes shall be required for all sewers greater than 18 inches in diameter or deeper than 12 feet, or where three or more eight inch or greater lines converge in the manhole.

The base section of the manhole shall be furnished in section lengths of 1, 2, 3, and 4 feet as required.

Reinforcing steel shall consist of a circular cage with a minimum cross sectional area of 3/10's of a square inch of steel per foot in both directions.

All joint surfaces of pre-cast sections and the face of the manhole base shall be thoroughly cleaned prior to setting the sections. Joints shall be sealed with a one inch flexible joint sealant which shall conform to the requirements of ASTM C 923.

9.4(c) WATER-TIGHTNESS: Water-tight concrete shall be required in all concrete manholes. Any cracks or imperfections developing at any point in the work shall be satisfactorily repaired. Materials and methods used shall be subject to approval of the County Engineer.

9.4(d) IRON CASTINGS: All iron castings shall conform to the requirements of ASTM A

48 (Class 30) for grey iron castings. Frames and covers shall have a minimum combined weight of 402 pounds.

The cover and ring seat shall be machined so that the entire area of the seat will be in contact with the cover, in any position of the cover on the seat. Frames and covers shall be so constructed and machined that the parts are interchangeable. The tops of the cover and frames shall be flush, and the clearance between the frame and cover shall be 1/8 of an inch all around. The top surface of each cover shall be cast with a studded pattern including the work "Sewer". Letters and studs shall be raised 3/8". Each cover shall be provided with not less than twelve ventilating holes of 3/4 inch diameter each.

All manhole frames shall be carefully set to the finished grade or as directed by the Engineer. Manhole frames shall be set in place on the manhole throat and shall be sealed with an approved flexible joint sealant which shall conform to the requirements of ASTM C 923. Frames or covers loosened from the manhole throat shall be reset and any frames, covers or throat sections damaged or broken shall be replaced prior to acceptance by the County.

9.4(e) MANHOLE STEPS: Manhole steps shall be constructed in accordance with the drawing "Manhole Steps" as shown in the appendix of these specifications and shall be similar in construction to the manhole step as manufactured by M.A. Industries, Inc., of Peachtree City Georgia.

The steps shall be constructed of number 4 (one-half inch diameter) grade 60 reinforcing steel bars bent and embedded in Copolymer Polypropylene Plastic.

The Copolymer Polypropylene Plastic, used to embed the reinforcing bars in, shall conform to the requirements of ASTM 214, Type II, Grade 43758, and the reinforcing bar shall conform to the requirements of ASTM A 615.

Manhole steps shall be installed at intervals not to exceed 18 inches between steps, be firmly cast into the concrete wall and taper sections of all manholes to a minimum depth of 3-3/8 inches, as shown in the drawings, and form a solidly anchored step which will not pull out or break under repeated use.

9.4(f) MANHOLE LEAKAGE TEST: All sewer manholes shall be tested for leakage prior to acceptance. Allowable leakage shall be one gallon per hour per manhole. At least two manholes shall be tested, and based on these tests and visual inspection of all manholes, additional tests may be required for other manholes. Any manhole which tests unsatisfactorily shall be repaired and retested until satisfactory results are obtained.

SECTION 10

CLEANING AND TESTING SANITARY SEWER LINES

10.1 GENERAL: This section specifies requirements for determining the acceptability of sewer systems.

10.2 CLEANING: After all sewer lines have been laid and the trench backfilled, the sewer lines shall be thoroughly cleaned and tested for leakage and alignment in the presence of the Engineer prior to acceptance by the County.

Cleaning shall be accomplished by introducing sufficient water at the upper end of the trunks and laterals to flush the lines completely clean of all foreign material. No debris shall be permitted to enter any sewer lines in service. All debris shall be removed at the lowest manhole of the extension. Other methods of cleaning may be used subject to approval by the Engineer. After the lines have been thoroughly cleaned, they shall be tested between each manhole for displacement.

10.3 DISPLACEMENT TEST: The displacement test shall be conducted by the Engineer in accordance with the following procedure:

A light shall be flashed between manholes or, if the manholes have not as yet been constructed, between the locations of the manholes, by means of a flashlight or by reflecting sunlight with a mirror. If the illuminated interior of the pipe shows broken, misaligned or displaced pipe, or other defects, the defects designated by the Engineer shall be remedied by the Contractor. After cleaning and inspection have been completed, the line shall be tested for leakage by one or more of the following methods.

10.4 AIR TESTING: The reach of pipe to be tested shall be isolated by completely blocking all outlets in the section under test. Careful attention shall be given to blocking all plugs. Prior to installing the lower and upper plugs, concrete pipe and manholes shall be wetted to minimize any loss of air through the pipe or manhole walls as a result of permeability in the dry condition. One of the plugs used at the manhole must be equipped to control the air entry rate and to prevent the pressure from exceeding five p.s.i.g. This shall be done by means of a blow-off valve set to operate a five p.s.i.g.

After the concrete pipe has been wetted and plugs installed, the air shall be allowed to slowly fill the pipe until a constant pressure of 4.0 p.s.i.g. is maintained for at least two minutes. During the two minute stabilization period all plugs and exposed fittings shall be checked with a soap solution. If a leak is found, the air shall be bled off, the leak repaired and a new two minute stabilization period begun. When the temperature of the air has reached equilibrium with that of the pipe wall, the air pressure shall be brought to four p.s.i.g. and the supply shall then be disconnected. When the pressure gauge reaches 3.5 p.s.i.g. a stop watch shall be started and then stopped when the pressure reaches 2.5 p.s.i.g. at an average pressure of 3.0 p.s.i.g. is used to calculate the rate of air loss. The

pipeline may be considered to have passed the air loss test successfully if the loss of air is not greater than a rate of 0.0030 cubic feet per minute per square foot of internal pipe surface. The following table shows the allowable time for the pressure to drop from 3.5 to 2.5 p.s.i.g. for respective pipe diameters.

Pipe Diameter	Time		Pipe Diameter	Time	
	Min.	Sec.		Min.	Sec.
6 inch	3	0	18 inch	8	30
8 inch	3	45	20 inch	9	30
10 inch	4	45	21 inch	10	0
12 inch	5	45	24 inch	11	15
14 inch	6	30	27 inch	12	45
15 inch	7	0	30 inch	14	0
16 inch	7	30	36 inch	17	0

10.5 EXFILTRATION TEST: In lieu of the standard sanitary sewer air test, the Contractor may make an exfiltration test in accordance with the following procedure:

The test section shall be blocked at both ends and the pipe subjected to a hydrostatic pressure produced by a head of water at a depth of three feet above the invert of the sewer at the upper manhole under test. In areas where ground water exists, the head of water shall be three feet above the existing water table.

For concrete pipe, the three foot head of water shall be maintained for a period of one hour to obtain full absorption of the pipe body and thereafter for a further period of one hour for the actual test leakage. For all other types of pipe, the three foot head of water shall be maintained for a period of one hour only. During the one hour test period the measured maximum allowable rate of exfiltration for any section of sewer, including service stubs, shall be as listed below:

SEWER MAIN DIAMETER (inches)	MAXIMUM DROP IN HEAD IN A 4 FOOT DIAMETER MANHOLE (Non-taper sect.) per 100 feet of sewer pipe	MAXIMUM ALLOWABLE EXFILTRATION (Gallons/Hour/100 Feet)
6	0.1563 inch	1.2
8	0.2031 inch	1.6
10	0.2500 inch	2.0
12	0.3125 inch	2.4
15	0.3594 inch	2.8
18	0.4063 inch	3.2
21	0.4531 inch	3.6
24 & larger	0.5156 inch	4.0

In case measurements indicate an exfiltration greater than the maximum allowable leakage, additional measurements shall be taken and continued until all leaks are located and the necessary repairs and corrective work have reduced the leakage in the section being tested below the maximum allowable by these specifications. For purposes of the test, the line between adjoining manholes will be considered a section and will be tested as such.

The Contractor shall furnish the plugs and other material and labor for placing the plugs in the sewer and shall assist the Engineer in making all measurements required. The introduction of any substance into the water used for testing with the intent of sealing such leaks as may be indicated will not be permitted.

If results of either the air test or the exfiltration test is not satisfactory, repairs or pipe replacement shall be required until the Engineer is satisfied that the leakage requirements are being met. All repair methods and materials used must be accepted by the Engineer.

10.6 PVC DEFLECTION TEST: All PVC pipe shall be mandrelled with a rigid device sized to pass through the pipe with 5% or less deflection of the pipe. These allowances shall include deformations due to all causes (wall thickness variations, shipping, production, backfill, heat, etc.). The mandrel device shall be cylindrical in shape and shall comply with the manufacturer's recommendations.

The mandrel shall be hand pulled by the contractor through all sewer lines. Any sections of sewer not passing the mandrel shall be uncovered and the contractor shall re-round or replace the sewer to the satisfaction of the engineer and all repaired sections shall be re-tested.

The deflection test shall be conducted after reaching final trench backfill grade and compaction.

10.7 INSPECTION AND FLUSHING: Prior to final acceptance of each section of sanitary sewer line, the Contractor shall flush a ball of full diameter of the sewer through all sewers up to 18 inches in diameter. Larger sewers shall be cleaned by other appropriate methods. All dirt and debris shall be prevented from entering the existing sewer system by means of water-tight plugs or other suitable methods.

Upon completion of the project, the Engineer will carefully inspect all sewers and appurtenances. Any unsatisfactory work shall be removed and replaced in a proper manner. The invert of the sewer and manholes shall be left smooth, clean, and free from any obstructions throughout the entire line. All manhole rings and covers shall be adjusted to finished grade prior to acceptance of the sewer system.

SECTION 11

WATER PIPE AND FITTINGS

11.1 GENERAL: The materials used for water pipe and fittings shall be all new and shall conform to the requirements for class, brand, size and materials as specified below. The Owner shall submit in writing a list of materials outlining the manufacturer and designation of all materials, and such list must be accepted by the County prior to the commencement of work.

A copy of the manufacturer's installation recommendations for each kind of pipe shall be provided to each foreman and inspector prior to construction. These recommendations shall be followed during construction unless instructed otherwise by the County Inspector or Engineer.

11.1(a) GENERAL PIPE REQUIREMENTS: Pipe materials shall conform to the following:

SIZE	TYPE
3/4" - 1"	Copper Type K or Polyethylene
1.5" - 2"	Schedule 40 PVC (sand bedded) (Schedule 80 Fittings)
Over 2"	Ductile Iron Class 52 or PVC C-900, Class 150 (sand bedded)

11.1(b) CONNECTING WATER METERS: Only authorized employees of the providing water company shall be allowed to connect or disconnect water meters. All boxes set in concrete shall be flanged to prevent settlement.

NOTE: Where these Specifications refer to AWWA Standards, a copy of these standards is available for review at the County Engineers office.

11.2 DUCTILE IRON PIPE: All ductile iron pipe shall be Class 52 conforming to the latest edition of AWWA Specification C-151 (ANSI A21.51). Pipe and accessories shall be gauged at sufficiently frequent intervals to insure that dimensions are in accordance with Table 51.3 and 51.4 of AWWA Specification C-151-76 for the gauge in accordance with the Standard Dimensions at sufficiently frequent intervals to assure dimensional control. The inside diameters of the sockets and the outside diameters of the spigot ends shall be tested with circular gauges.

Unless otherwise specified, all Ductile Iron Pipe furnished under these Specifications shall be designed in accordance with AWWA Specification C-150-76 "American National Standard for the Thickness Design of Ductile Iron Pipe." The maximum allowable variation with the standard pipe thickness

shall not be more than those shown in the following table and note:

PIPE DIAMETER (INCHES)	MINUS TOLERANCE (INCHES)
3-8	0.05
10-12	0.06
14-42	0.07
48	0.08

NOTE: All additional tolerance of 0.02 inches shall be permitted over areas not exceeding eight inches in length.

Each pipe shall be weighed before the application of any coating other than the standard bituminous coating, and the weight shall be shown on the outside or inside of the bell or spigot end. The weight of any single pipe shall not be less than the tabulated weight by more than 5% for pipe larger than 12 inches in diameter. The total weight of any order 25 tons or more shall be not more than 2% under the total nominal weight.

The nominal laying length of the pipe shall be as shown on Table 51.3 and 51/4 of AWWA Specification C 151-76. A maximum of 10% of the total number of pipe of each size of an order may be furnished as much as 24 inches shorter than the nominal laying length. An additional 10% may be furnished as much as three inches shorter than the nominal laying length.

11.2(a) PHYSICAL AND MECHANICAL PROPERTIES: The Ductile Cast Iron Pipe shall conform with all requirements of the ANSI Specification A21.51. The physical properties shall not be less than 60-42-10.

Each pipe shall be subjected to a hydrostatic test of not less than 500 psi. The test may be made either before or after the standard outside coating and bituminous inside coating have been applied, but shall be made before the application of a cement lining or of a special lining. The pipe shall be under the full test pressure for at least ten seconds. Any pipe that leaks shall be rejected.

11.2(b) MARKING: Each pipe shall be legibly marked "Ductile". The weight, a manufacturer's mark, and the year in which the pipe was produced shall be cast or marked on the pipe.

11.2(c) INSPECTION: The manufacturer shall establish the necessary quality control and inspection practice to assure compliance with these specifications. The manufacturer shall, if required in the Special Provisions, furnish a certified statement that the inspection and all the specified tests have been made and the results thereof comply with the requirements of these specifications. When the Owner desires to inspect the pipe at the manufacturer's plant, the Owner will so specify in the Special Provisions and state the extent of the inspection. The Owner's inspector shall have free access

to those parts of the manufacturer's plant which are necessary to assure compliance with these specifications. The manufacturer shall provide the inspector with assistance to handle pipe as may be necessary.

11.2(d) REJECTION OF PIPE: At least one tensile and one impact sample shall be taken during each casting period of three hours. Samples shall be selected to properly represent extremes of pipe diameters and thicknesses. If the results of any physical acceptance test fails to meet the requirements of these specifications, all pipe cast in the same sampling period shall be rejected. The manufacturer may determine the extent of rejections by making similar additional tests of pipe until the rejected lot is bracketed (in order of manufacturer) by an acceptable test at each end of the period of question. When pipe of one size is rejected from a sampling period, the acceptability of pipe of different sizes from the same period may be established by making the routine acceptance test for these sizes.

11.2(e) JOINTS: Ductile Iron Pipe shall be either Mechanical Joints, Rubber Gasket Slip-on Joints, Flanged Joints, or a combination of the above as specified on the plans.

(1) MECHANICAL JOINTS: Mechanical joints and the rubber gaskets and lubricant therefore, for Ductile Iron Pipe, shall comply with the requirements and be dimensioned in accordance with the latest edition of AWWA Specification C-104, C-110, and C-111.

Bolts and rubber gaskets shall be furnished with mechanical joint pipe in sufficient quantity for the amount of pipe ordered.

(2) RUBBER GASKET SLIP-ON JOINT: Rubber gasket slip-on joints, and the rubber gaskets and lubricant therefore, for Ductile Iron Pipe shall comply with the general requirements of AWWA C-151 and C-111.

Rubber gasket slip-on joints shall be designed for assembly by pre-positioning of a single continuous molded rubber ring gasket in an annular recess in the pipe socket a positive seal. The plain end of the pipe shall be suitably beveled to facilitate assembly.

The design and shape of the gasket, and the annular recess therefore, shall be such that the gasket is locked in place against displacement as the joint is assembled. The gasket shall provide adequate compressive force between the plain pipe end and the socket after assembly to effect a positive seal under all combinations of joint and gasket tolerances.

Details of the joint and rubber ring gasket design and assembly shall be in accordance with the pipe manufacturer's standard practice. The Owner shall furnish the Engineer detail drawings in quadruplicate, showing the design of the joint prior to casting said pipe. The design of the joint shall be subject to the approval of the County Inspector.

The recess in the pipe socket for the rubber ring shall be free of all coating materials and sand

pits.

Rubber gaskets and lubricant shall be furnished with rubber gasket joint pipe in sufficient quantity for the amount of pipe ordered.

(3) FLANGED JOINTS: Cast iron pipe flanges, and bolts and nuts therefore, shall be dimensioned in accordance with ANSI B-16.2 for Class 200. Threads for screw-on flange pipe shall comply with ANSI B-21. Flange bolts, nuts and gaskets shall be furnished with flange joint pipe in sufficient quantity to make each joint for the pipe ordered. Flanged fittings and spools shall conform to AWWA C-104, C-110 and C-115.

11.2(f) LINING AND COATING: The waterway surfaces of all Ductile Iron water pipe and fittings shall be completely covered with a uniform thickness of cement mortar which shall be further covered with a bituminous seal coat, all in accordance with AWWA C-104. The bituminous seal coat may be omitted if the cement lining is given a seven day water cure, during which the lining is kept consistently damp.

Ductile Iron Pipe or Fittings lined in the field will not be accepted as conforming to AWWA C-104.

The outside surface of all Ductile Iron Pipe for general use under all normal conditions shall have a bituminous coating of coal tar primer approximately one mil thick, unless otherwise specified. The finished coating shall be continuous and smooth. It shall be neither brittle when cold, not sticky when exposed to the sun, and shall strongly adhere to the pipe.

11.2(g) POLYETHYLENE WRAPPING: A polyethylene wrap will be required on all ductile iron pipe laid in corrosive soils or where directed by the County Engineer. The polyethylene wrap tubing shall be cut to provide for a minimum of one foot of lap over both the adjoining pipes. The ends of the tubing shall be wrapped using three circumferential turns of plastic adhesive tape. The loose wrap on the barrel shall be pulled snugly around the barrel of the pipe and the excess folded over at the top. This fold shall be held in place by means of six inch strips of plastic tape placed at intervals of three feet along the pipe barrel.

Bends, reducers, and off-sets shall be wrapped in the same manner as the pipe. Valves shall be wrapped by bringing the tube wrap on the adjacent pipe over the bells of the valve and sealing with adhesive tape. The valve bodies shall then be wrapped with flat sheets passed under the valve bottom and brought up around the body to the stem and fastened with the tape.

11.3 POLYVINYL CHLORIDE (PVC) PIPE: All rigid polyvinyl chloride (PVC) pipe used in public water main systems in the County shall conform to AWWA Specification C-900, which outlines the requirements for rigid polyvinyl chloride (PVC) pipe for water main systems. When used for potable water systems, the pipe shall also meet the National Sanitation Foundation Standard No. 14 for Plastic Piping System Components and Related Materials.

11.3(a) MATERIALS: Polyvinyl chloride pipe shall be extruded from virgin PVC meeting the requirements of Cell Classification 12454 A or 12454 B as defined in ASTM D 1784. The PVC compounds used in the pipe manufacture shall also be listed by the National Sanitation Foundation (NSF) for use in potable water pipe.

11.3(b) PIPE: All PVC pipe shall be manufactured to cast or ductile iron size outside dimensions with DR's and tolerances in compliance with AWWA Standard C-900, PVC Pressure Pipe, 4" through 12" for water. The pipe shall be listed by NSF, the Underwriters' Laboratories (U/L) and Factory Mutual for use in underground fire protection services. Laying length shall be twenty feet, plus or minus one inch for all sizes, except that up to 15% of the footage may be in random lengths of not less than 10 feet.

11.3(c) BELLS AND GASKETS: The pipe shall have an integral bell end and the gaskets seal shall be reinforced with a steel band or other rigid material as per ASTM D 3139. Joints for Plastic Pressure Pipe Using Flexible Elastomeric Seals shall conform to ASTM Specification F-477.

11.3(d) MARKINGS: Markings on the pipe shall include:

1. Nominal Size and O.D. base (e.g. 8" G.I.S.)
2. Material cell classification (PVC 12454-A or B)
3. Dimension ratio number (DR25, 18, or 14)
4. AWWA pressure class (PC 150 or 20) and hydrostatic test pressure (e.g. T800)
5. AWWA designation number (AWWA C-900)
6. Manufacturer's name or trademark and production code
7. Seal of the testing agency that verified the suitability of the pipe and material for potable water or fire prevention service.

11.3(e) TEST REQUIREMENTS: Each length of pipe (standard and random) including the integral bell, shall be pressure tested to four times the rated pressure for a minimum of five seconds. Pipe shall meet all additional test requirements as described in AWWA C-900.

11.4 SERVICE PIPE: Where service lines are one inch or less in diameter, copper pipe or polyethylene pipe shall be used. Pipe which have outside dimensions greater than one inch in diameter shall not be copper. All copper pipe shall conform to the following specifications:

11.4(a) COPPER: Pipe may be used which conforms to the requirements of ASTM B88. The pipe shall be of a Type K only and shall be dimensioned so as to allow the connection to AWWA standard water service taps and fittings. The pipe shall have surfaces smooth and free from bumps and irregularities.

POLYETHYLENE: Service lines may be with new High Density Polyethylene 200 psi Water Tubing suitable for underground burial. This material shall be supplied in conformance with all the applicable standards of ASTM D1248, ASTM D2737 or D2239, NSF-14, and AWWA

C901.

11.4(b) INSTALLATION: The pipe shall be installed as per the manufacturer's specific instructions and also the Utah Plumbing Code. Fittings and joints shall comply with specification AWWA C-800. The pipe shall be installed with continuous support under the full length of the barrel. No pipe shall be installed where a dry joint connection cannot be made. All buried water lines shall be installed with a minimum soil cover of 36 inches.

11.4(c) TESTING: Testing shall be done in accordance with the manufacturer's specific instructions and also under the guidelines of the County Inspector.

11.4(d) SERVICE CONNECTIONS: The installation of service connections shall use only connections, equipment and practices recommended by the manufacturer. The service connection shall conform to the detail drawing shown in the Appendix of these Specifications.

11.5 FITTINGS: Fittings shall be Schedule 80 PVC or Cast Iron and of a pressure rating as may be required by the static pressure along the pipeline. All fittings shall be dimensioned according to ANSI A-21.10 (AWWA C 110) or AWWA C 153, "American Standard for Cast Iron Fittings, 3 inches through 48 inches, for Water and other Liquids".

11.5(a) SETTING OF BENDS, TEES, CROSSES AND REDUCERS: Bends, tees, crosses, and reducers shall be lowered into the trench, inspected, cleaned and joined to the pipe.

Reaction or thrust blocking shall be applied at bends and tees, and at points at reducing or in fittings where changes in pipe diameter occur. The design of concrete thrust blocking shall be as shown on contract drawings or as directed by the County Engineer. (Standard thrust blocking details are shown in the Appendix of these specifications.) The material for reaction or thrust blocking shall be concrete composed of concrete aggregates in accordance with ASTM Designation C33, Portland Cement in accordance with ASTM Designation C150. If an air-entraining agent is used, it shall conform to ASTM Designation C175 and C260. The mix shall not be leaner than one part cement, two and one-half parts sand, and five parts stone, and shall have a compressive strength of not less than 2,500 psi. Blocking shall be placed between solid ground and the fitting to be anchored. The area of bearing on the fitting and on the ground shall in each instance be that required in the drawings or by the Engineer. Unless otherwise directed by the Engineer, the blocking shall be placed so that the pipe and fitting joints will be accessible for repair. Metal harnesses or tie rods and pipe clamps may be used to prevent movement in lieu of thrust blocks directed by the Engineer. Tie rods and clamps shall be galvanized or otherwise rust-proofed or painted.

11.5(b) PLUGGING OF DEAD ENDS: Standard plugs shall be inserted into the bells of all dead-end fittings. Spigot ends of fittings and plain ends of pipe shall be capped. A concrete reaction or thrust block shall be provided at all plugged outlets to fittings in the sizes indicated on the contract drawings or as directed by the Engineer. They also shall be tied to the fittings with clamps and tie rods. The number and size of rods shall be as specified.

11.6 TAPPING MATERIAL SPECIFICATION: For small tapplings (3/4" through 2") tapped into asbestos cement, cast iron steel or PVC pipe, the following materials shall be required:

11.6(a) SADDLE CASTINGS: Large saddle tapplings shall be similar to "Romac Stainless Steel Saddles" constructed of high tensile ductile (modular) iron, in accordance with ASTM Specification 536-71, and shall be covered by a black nylon fused coat, approximately 10-12 mils thick, with an approximate dielectric strength of 1000 volts per mill.

11.6(b) STAINLESS STEEL STRAP: The stainless steel strap shall consist of a two inch wide strap to spread out the clamping force on the pipe and shall come complete with sufficient bolts, nuts and washers (with 5/8" N.C. Teflon coated roll threads) to property clamp the strap to the pipe. M.I.G. welds shall be pasivated for resistance to corrosion.

11.6(c) GASKETS: Gaskets shall be made from virgin SBR compounded for water services.

11.7 VALVES AND BOXES: All valves, 8" and smaller, shall be of a resilient seat gate valve type, and all valves over 8" shall be butterfly valves unless otherwise specified by the County Engineer.

11.7(a) GATE VALVES: All gate valves shall have a resilient seat conforming to AWWA Specification C-500. However, in case of a conflict, the requirements of this paragraph shall govern. Valves shall have mechanical joint, flanged, flanged by mechanical joint, rubber gasket slip-on joint end connections as required by the joining pipe or fittings, and shall have a list number four "O" ring type stuffing box.

Valves shall be installed vertically in a horizontal run of pipe, and shall be provided with a two inch square operating nut for manually operating the valve with a "T" handle wrench. The direction of rotation to open shall be to the left (counter-clockwise).

11.7(b) BUTTERFLY VALVES: All butterfly valves shall be of the tight-closing, rubber-seat type with rubber seats that are securely fastened to the valve body. No metal to metal seating surfaces shall be permitted. Valves shall be bubble-tight at rated pressures with flow in either direction, and shall be satisfactory for application involving valve operation after long period of inactivity. Valve discs shall rotate 90° from the full open position to the tight shut position. Valves 20 inches and smaller shall meet the full requirements of AWWA Standard C504-80 for Class 150B. The manufacturer shall have manufactured tight-closing, rubber-seal butterfly valves for a period of at least five years. All valves shall be similar to those as manufactured by the Henry Pratt Company or approved equal.

Valve bodies shall be constructed of cast iron ASTM A-126 Class B (for flanged end valves) or ASTM A-48 Class 40 for safer type valves. Flange drilling shall be in accordance with ANSI B16.1 Standard for cast iron flanges. Two trunnions for shaft bearings shall be integral with each valve body. Body thickness shall be in strict accordance with AWWA Standard C504-80.

11.5(c) SERVICE LINES: All service lines shall be installed according to the details shown on the plans. All service lines shall be connected to the pipeline using an appropriately sized tee. The service lateral shall also include the installation of a gate valve.

11.5(d) PIPE TO BE KEPT CLEAN: All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench. Pipe shall be kept clean by means approved by the Engineer during and after laying.

11.5(e) JOINTING PIPE SECTIONS: The sealing surface of the pipe, the bell to be joined, and the elastomeric gaskets shall be cleaned immediately prior to assembly, and assembly shall be made as recommended by the manufacturer. When pipe laying is not in progress, the open ends of installed pipe shall be closed to prevent entrance of trench water into the line. Whenever water is excluded from the interior of the pipe, enough backfill shall be placed on the pipe to prevent floating. Any pipe that has floated shall be removed from the trench and the bedding restored. No pipe shall be laid when the trench conditions or the weather are unsuitable for proper installations as determined by the County Inspector.

11.5(f) CUTTING PIPE: The pipe shall be cut in a neat and workman-like manner without damage to the pipe so as to produce a smooth end at right angles to the axis of the pipe.

11.5(g) END PREPARATION: Pipe ends shall be cut square, deburred and beveled in accordance with the pipe manufacturer's recommendations.

11.5(h) PUSH-ON JOINTS: The push on joint shall be a single elastomeric gasketed joint which shall be assembled by positioning the elastomeric gasket in the annular groove of the bell and inserting the spigot end of the pipe into the bell. The spigot end of the pipe shall compress the gasket radially to form a positive seal. The gasket and annular groove shall be designed, sized and shaped so that the gasket will resist displacement. Care shall be taken so that only the correct elastomeric gasket, compatible with the annular groove of the bell, is used. Insertion by the elastomeric gasket in the annular groove of the bell must be in accordance with the manufacturer's recommendations.

11.5(i) MECHANICAL JOINTS: The mechanical joint shall be a bolted joint of the stuffing box type, and installation recommendations from the manufacturer shall be followed. Each joint shall consist of:

- (1) A bell provided with an exterior gland having bolt holes or slots and a socket with an annular recess for the sealing gasket and spigot end of the plastic pipe.
- (2) A sealing gasket.
- (3) A follower gland with bolt holes matching those in the fitting.
- (4) Tee bolts and hexagonal nuts.

Valve discs shall be constructed of alloy cast iron ASTM A436 Type I (Ni-Resist).

Shafts of all valves shall be turned, ground and polished. Valve shafts shall be constructed of 18-8 Type 304 or Type 316 stainless steel. Shaft diameters shall meet minimum requirements established by AWWA Standard 75 lbs. pull under test procedure ASTM D-429, Method B.

Valves shall be fitted with sleeve-type bearings. Bearings shall be corrosion resistant and self-lubricating. Bearing load shall not exceed 1/5th of the compressive strength of the bearing of shaft material. Packing shall be self-adjusting Chevron type. Valve operators shall conform to AWWA C504-80.

Manual operators shall be of the traveling nut, self-locking type and shall be designed to hold the valve in any intermediate position between fully open and fully closed without creeping or fluttering. Operators shall be equipped with mechanical stop-limiting devices to prevent over-travel of the disc in the open and closed positions. Valves shall close with a (clockwise) rotation. Operators shall be fully enclosed and designed to produce the specified torque with a maximum pull of 80 lbs. on the handwheel or chain-wheel. Operator components shall withstand an input of 450 Ft. Lbs. at extreme operator position without damage.

11.7(c) VALVE BOXES: All valves shall be provided with a Cast Iron valve box of the extension sleeve type, and the correct adjustable height to bring the top of the valve box flush with the ground surface. The valve box shall not be less than five inches in diameter and shall have a minimum thickness of .316 inch. The box provided also shall be provided with a suitable base and cover. The word "WATER" shall be cast on the cover. The contractor or owner shall furnish a one inch operating wrench and handle for each five new valves installed on each project. Valve boxes shall be installed plumb and properly positioned to allow access of the operating wrench. To insure that the box is not displaced during backfill operation, the backfill shall be hand mechanical tamped for a distance of five feet each way along the trench.

11.7(d) METER BOXES: All meter boxes shall be located in the sidewalk, behind the curb (out of driveways where possible). Any meter box covered or damaged during the construction operations shall be replaced or uncovered and raised to finish grade by the contractor. Meter boxes shall be secured to the concrete sidewalk with a minimum of four (6" x 1/2") anchor bolts secured to the box and anchored in the concrete sidewalk.

In areas of the County which have no sidewalks, meter boxes shall be flush or one inch above the finish grade.

11.8 MATERIAL: The material used for water service connections shall comply with the following:

11.8(a) COPPER SERVICE PIPE: Copper service pipe shall be seamless and suitable for use as copper underground service connections and shall conform to Section 11.4 of these Specifications.

11.8(b) CURB STOPS: Curb stops shall be similar to Mueller, Ford or equal and shall be suitable for flared copper inlet and inside pipe thread outlet. All stops shall be approved by the providing water company.

11.8(c) CORPORATION STOPS: Corporation stops shall be similar to those manufactured by the Mueller Company or Ford and shall conform to the several designations shown in the table below for the various sizes.

WATER SERVICE CONNECTION SIZE				
	3/4"	1"	1-1/2"	2"
MUELLER CO.	H-150000	H-150000	H-1510	H-15010
FORD	F600 or F560	F600 or F500	F6125	F6125

All services shall have a flare type joint for service pipe which is threaded on the inlet and with an AWWA corporation stop thread or IPS thread.

11.8(d) METER SETTER YOLKS: Meter setters or meter yolks shall have a built-in back-flow device and shall have a corrosion-resistant bronze body; dual acetal plastic valves with natural rubber gaskets that are independently acting and capable of giving two levels of protection; stainless steel springs that resist corrosion; and a resilient O-ring end-tap seal. All internal parts shall be accessible without removing the valve from the line. Meters shall only be installed by providing water company personnel.

11.8(e) BUILDING SERVICE CONNECTIONS: At all points designated by the Water Company, the owner shall install services for building connections and shall extend such services to the property line, unless otherwise indicated by the County Engineer. Individual water services shall be 3/4" from the water main to the curb stop for normal domestic service, but may be one, one and 1/2 or two inches in diameter as directed by the County Engineer. Services shall have a minimum of three feet of cover and be laid as shown on the detail drawing in the Appendix of these specifications.

11.9 FIRE HYDRANTS: Fire hydrants shall conform to the latest edition of AWWA C-502, "Dry Barrel Fire Hydrants." All hydrants shall be designed for a working pressure of 200 psi and a hydrostatic pressure of 350 psi. It shall be the responsibility of the Owner to furnish hydrants with a finish paint above the ground line identical to the existing hydrant paint (red). After the hydrant is installed, it will be the water company's responsibility to maintain the hydrant and, where applicable, the Owner will allow access to the water company to do so.

11.9(c) HYDRANT DETAIL: The hydrant shall be of a flanged joint type or mechanical joint inlet. Mechanical joints have limited uses and shall be identified for use by the water company. All hydrants shall be so designed as to allow the flanges at sidewalk level to separate without material damage to the main barrel section when struck by a large object, such as a car. Upon such damage,

the main gate must remain closed to avoid flooding or washout. Hydrants with a five inch valve opening shall be furnished with two 2 1/2" National Standard Thread Hose Nozzles and one 4-1/2 inch National Standard Thread Pumper Nozzle. All nozzles shall be furnished with a cap and gasket with attaching chain. All hydrants shall open counter clockwise with a pentagon operating nut conforming in size to the specifications of the water company and County. (A hydrant detail is shown in the Appendix of these Specifications.)

11.9(b) SETTING HYDRANTS: Fire hydrants shall be set so that at least the minimum pipe cover is provided for the branch supply line and the nozzles are at least 18 inches above finish grade. Each hydrant shall be set on a concrete foundation at least 18 inches square and four inches thick. Each hydrant shall be blocked against the end of the trench with concrete. Hydrant drainage shall be provided by installing gravel or crushed rock around the hydrant, and below the top of the hydrant supply line. One third cubic yard and one and 1/2" gravel shall be placed around the drain holes just above the hydrant valve casing. All hydrants shall stand plumb. Hydrant pumper nozzles shall have hose nozzles parallel and perpendicular to the curb line. Hydrants shall be located inside the street right of way and/or as directed by the County Engineer.

11.9(c) TIMING OF INSTALLATION: When fire hydrants are to be installed in a development, such fire protection facilities, including all surface access roads, shall be installed and made serviceable prior to the construction of the development.

SECTION 12

CLEANING AND TESTING WATER SYSTEMS

12.1 GENERAL: The owner and/or contractor shall disinfect and test all water mains prior to final acceptance by the County. This shall include the repairing of existing facilities that must be included in the test but are not capable of holding test pressures. All concrete reaction blocks shall be in place at least five days before the initial filling of the line unless high early strength concrete is used which will require three days in place.

12.2 CLEANING AND DISINFECTION: Each line, after being tested and before being placed in service, shall be disinfected by chlorination. Prior to chlorination the entire line shall be flushed to insure that all dirt or foreign objects have been removed from the line. Sufficient chlorine shall be added to insure a residual of 25 parts per million in the water after 24 hours standing in the pipe. Chlorine calcium hypochlorite dry chlorinating chemical solution may be used for this purpose. Methods of application shall be approved by the County Engineer or Inspector. Following chlorination, all treated water shall be drained and the pipeline thoroughly flushed with clean water.

The entire line shall be flushed after the specified contact period. Such flushing shall be continued until the water is free from excess chlorine. The entire line, including hydrant laterals, branch lines, and dead end mains shall be flushed. The discharge of flushed water shall be accomplished in such a manner that no erosion will occur and with no damage to streets or other property. Procedures for discharge will be subject to the review of the County Engineer and Inspector.

12.3 PRESSURE TEST: After the pipe has been laid, including fittings, valves, corporation stops, services, and hydrants, and the line has been backfilled in accordance with Section 3 of these Specifications, each valved section, unless otherwise directed by the County Inspector, shall be subjected to hydrostatic pressure of not less than 200 pounds per square inch. The duration of each such test shall be two hours. Water added to maintain the pressure shall not exceed 0.4 gallons per inch diameter per 1000 lineal feet of main being tested during the two hour test period.

Each valved section of pipe shall be slowly filled with water and the specified test pressure measured at the lowest point of elevation. This shall be applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, gauges, and all necessary apparatus shall be furnished by the Owner. Gauges and measuring devices must meet with the acceptance of the County Engineer or Inspector and the necessary pipe taps shall be made as directed. Before applying the

specified test pressure, all air shall be expelled from the pipe by drilling small holes at points of highest elevations and afterward tightly plugging those holes with brass plugs.

Any cracked or defective pipes, fittings, valves, or hydrants discovered in the pressure test shall be removed and replaced with south material in the manner provided. The test shall be repeated until the water main passes the pressure test and is accepted by the County Inspector.

12.4 OPERATIONAL INSPECTION: At the completion of the project and in the presence of the Inspector, the Owner shall operate all valves, hydrants, and water services to ascertain that the entire facility is in good working order; that all valve boxes are centered and valves are operational; that all hydrants operate and drain properly; that all curb boxes are plumb and centered; and that water is available at all curb stops.

SECTION 13

RESTORATION OF SURFACE IMPROVEMENTS

13.1 GENERAL: The Contractor shall be responsible for the protection and the restoration or replacement of any improvement existing on public or private property at the start of work or placed there during the progress of the work. Existing improvements shall include but are not limited to asphalt surfacing, curbs, ditches, driveways, culverts, fences, signs, sidewalks, landscaping and walals. All improvements shall be reconstructed to equal or better, condition than the condition of the existing improvements prior to their removal.

All traveled surfaces shall be maintained flush with the existing surfaces at all times until permanent repairs are completed.

13.2 ROAD BASE: Where trenches are excavated through gravel surfaced areas, such as roads and driveways etc., the gravel surface shall be retored and maintained as follows:

- (a) The gravel shall be placed deep enough to provide a minimum of six inches of material.
- (b) The gravel shall be placed in the trench at the time it is backfilled. The surface shall be maintained by blading, sprinkling, rolling, adding gravel, etc., to maintain a safe uniform surface satisfactory to the County Engineer. Excess material shall be removed from the premises immediately.
- (c) Material for use on gravel surfaces shall conform to Section 3 of these Specifications.

13.3 BITUMINOUS SURFACE: Where trenches are excavated through bituminous surfaced roads, driveways or parking areas, the surface shall be restored within five days as follows:

- (a) Mud or other soft or spongy material shall be removed from the trench and the space filled with granular backfill to within eight inches of finish grade. The pit-run gravel shall be rolled and tamped to a minimum of 95% of maximum dry density in layers not exceeding six inches in compacted thickness. Base gravel shall then be placed to a depth equal to the original gravel base, but not less than six inches thick and compacted to a minimum of 95% of maximum dry density.

(b) Prior to permanent resurfacing, the contractor shall saw-cut the existing paving to vertical, clean, straight lines as nearly parallel to the center line of the trench as practical. The existing bituminous paving shall be cut back beyond the limits of any excavation so that the edges of the new paving will rest on at least six inches of undisturbed soil.

(c) Pavement restoration shall include priming of pavement edges and the gravel base with type MC-70 bituminous material, and placing and rolling plant mix asphalt to the level of the adjacent pavement surfaces.

(d) The bituminous surface shall be restored by standard paving practices to a thickness equal to the original pavement but not less than two inches. The finished repaired surface shall not deviate more than 1/4 inch (vertically) from the existing road surface. Any deviations greater than that specified shall be immediately removed and replaced to the proper standards.

13.4 CONCRETE SURFACES: All concrete curbs, gutter, sidewalks, and driveways shall be removed and replaced to the next joint or score line beyond the actually damaged or broken sections; or saw-cut to neat, plane faces. All new concrete shall match, as nearly as possible, the appearance of adjacent concrete improvements unless adjacent improvements do not meet these specifications.

All concrete work shall conform to the requirements of Section 5 of these specifications.

SECTION 14

PAINTING AND PAVEMENT MARKINGS

14.1 GENERAL: This section covers the painting of pavement markings and all structural and non-structural steel, box lids and grates. Pavement markings shall include all traffic lane striping, parking stalls, and other traffic oriented street markings.

14.2 STEEL AND STRUCTURAL STEEL PAINTING: Unless otherwise specified, one shop or prime coat and one finish coat of paint shall be required on structural or non-structural steel with a minimum dry film thickness of one and one-half mils per coat. The paint finish coat shall be light gray unless specified otherwise.

14.2(a) SURFACE PREPARATION: All surfaces to be painted shall be sand blasted to a commercial grade and coated with one coat of primer the same day as sand blasting is performed.

14.2(b) PAINT SYSTEMS: All paint coatings shall be applied with a brush, roller or spray gun in strict compliance with the manufacturers instructions. Mixing and thinning of all paints used shall also be accomplished in strict compliance with the manufacturers instructions.

All structural steel (not embedded in concrete) shall be primed with a coat of red lead enamel and shall be finished with a coat of light gray enamel paint.

All non-structural steel (box lids and grates) shall be primed with a coat of red lead heavy-duty epoxy paint, and shall be finished with a coat of light gray, heavy-duty epoxy paint.

14.2(c) APPLICATION: Paint shall be applied only when all of the following conditions are met:

- (1) The air temperature is above 50° F.
- (2) The surface temperature of the material to be painted is between 40° and 100° F.
- (3) The surface to be painted is clean and dry.

Material painted under cover in dam or cold weather shall remain covered until dry or until weather

TYPICAL ROAD CROSS SECTIONS

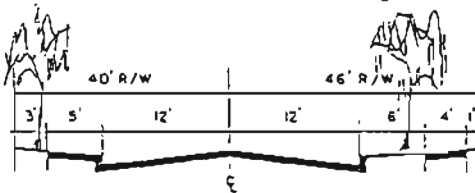
TYPICAL HALF STREET CROSS SECTIONS

Showing Integral
Curb, Gutter, Sidewalk

Showing Separated
Curb and Sidewalk

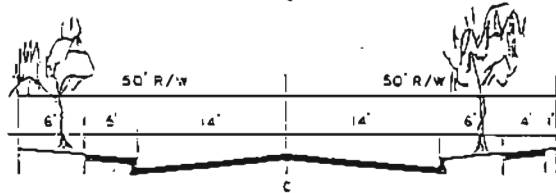
PRIVATE STREET - RECOMMENDED

MODIFICATIONS TO BE APPROVED BY
PLANNING COMMISSION



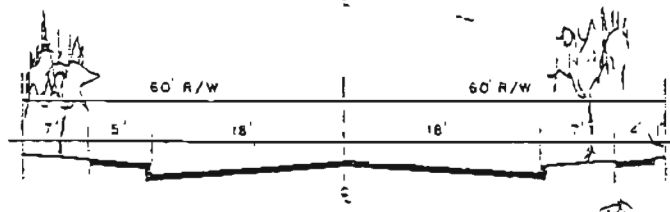
MINOR STREET - AND FRONTAGE ROAD

NO PARKING - TWO LANES MOVING
PARKING ONE SIDE - TWO LANES MOVING
PARKING TWO SIDES - ONE LANE MOVING



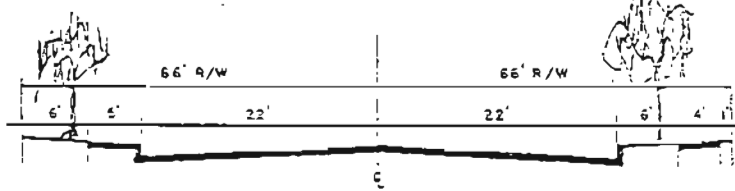
MINOR STREET MAY BE REQUIRED BY
PLANNING COMMISSION

PARKING TWO SIDES - TWO LANES MOVING

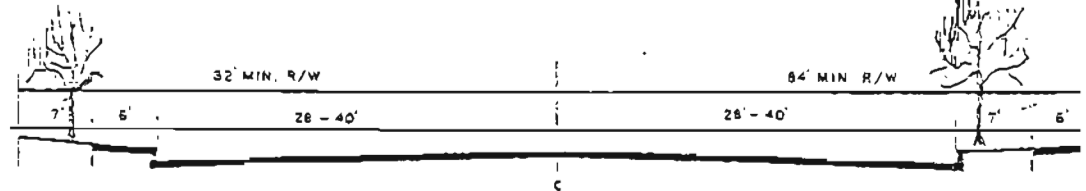


COLLECTOR STREET

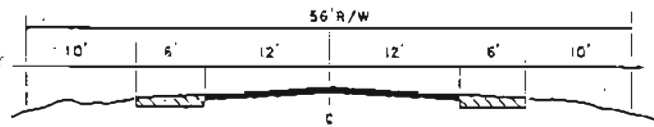
PARKING TWO SIDES - TWO LANES MOVING



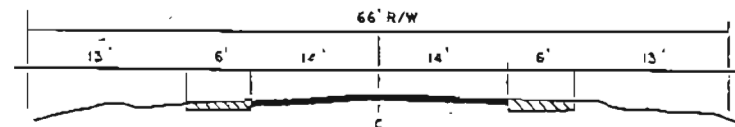
MAJOR STREET



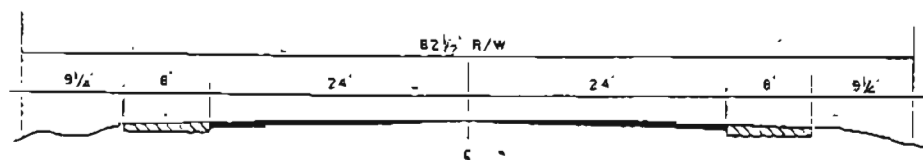
RURAL ACCESS



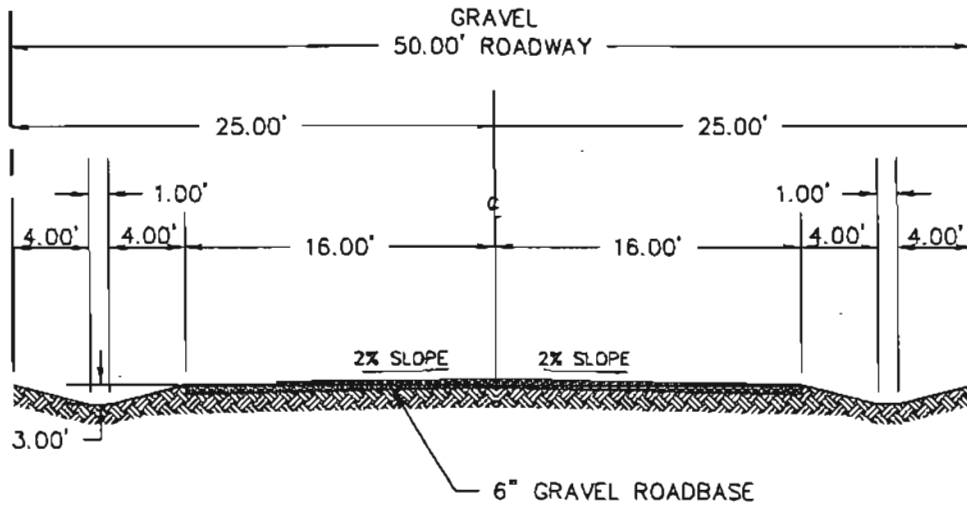
MINOR COLLECTOR



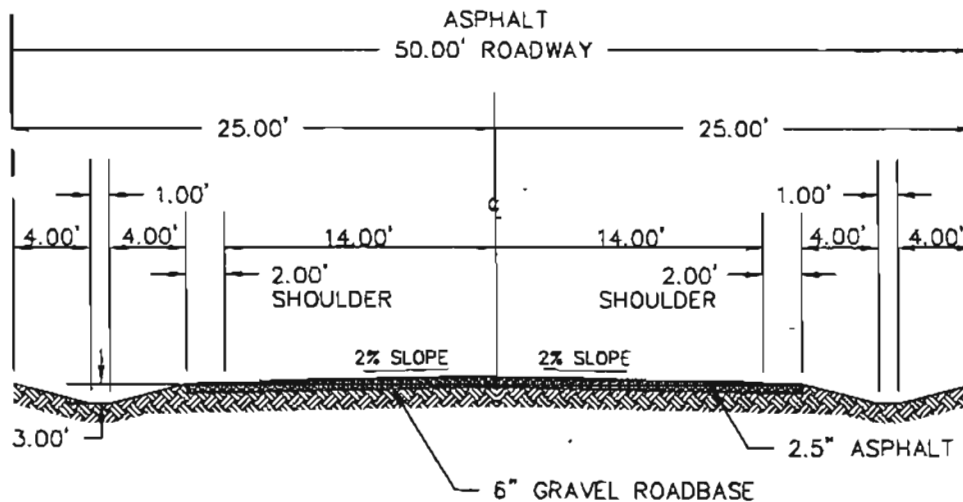
MAJOR COLLECTOR



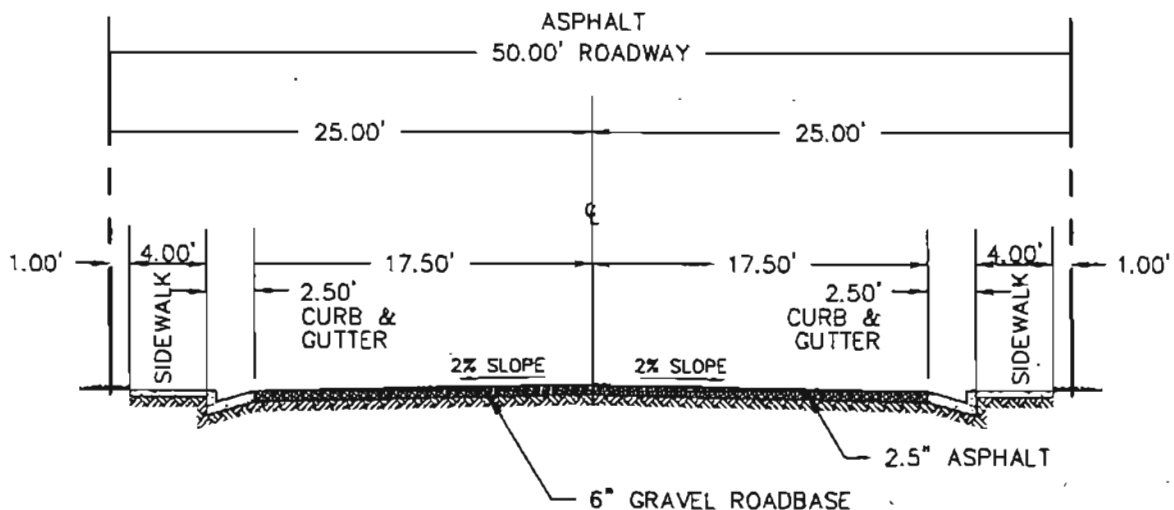
STANDARD DRAWING R-01 50.0' STREET CROSS-SECTIONS



50.00' WIDE ROAD
WITH NO ASPHALT, CURB, GUTTER
OR SIDEWALK

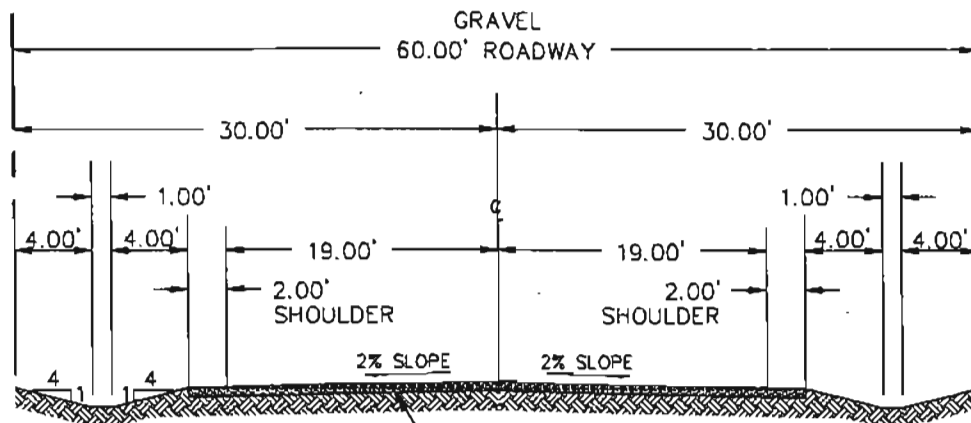


50.00' WIDE ROAD
WITH NO CURB, GUTTER OR SIDEWALK

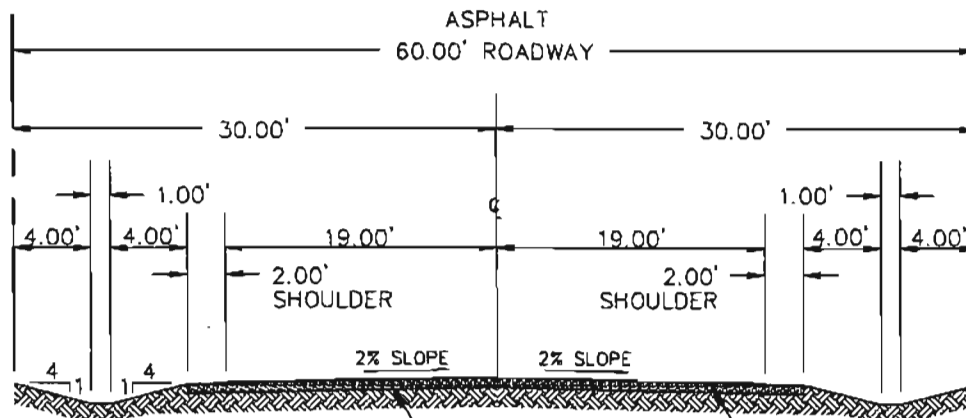


50.00' WIDE ROAD
WITH CURB, GUTTER AND SIDEWALK

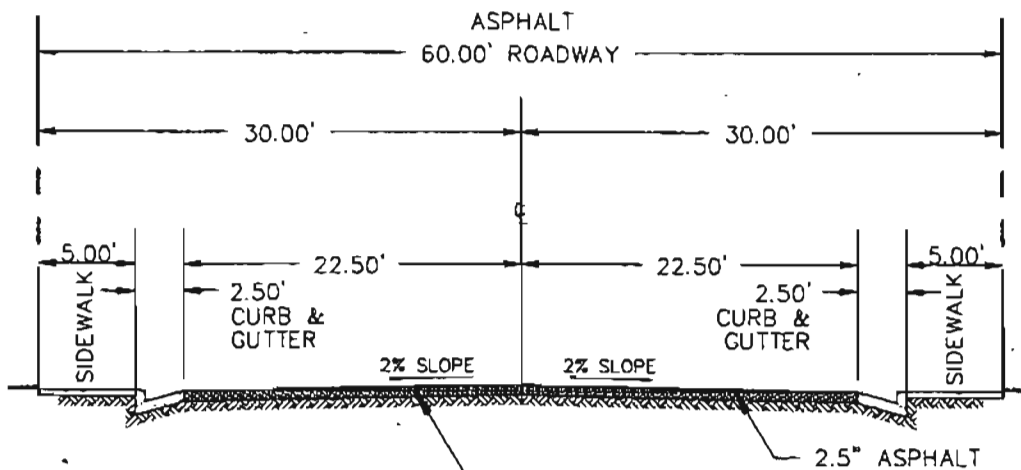
STANDARD DRAWING R-02 60.0' STREET CROSS-SECTIONS



60.00' WIDE ROAD
WITH NO ASPHALT, CURB, GUTTER
OR SIDEWALK

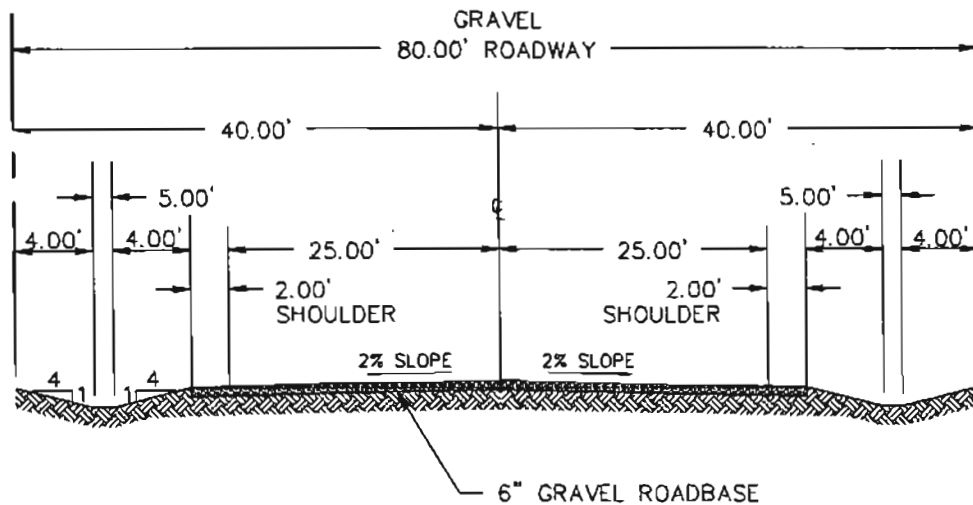


60.00' WIDE ROAD
WITH NO CURB, GUTTER OR SIDEWALK

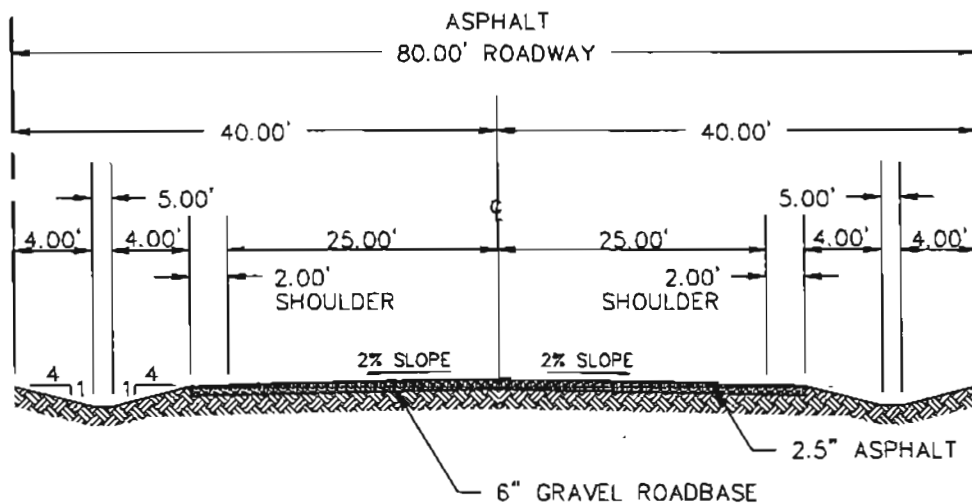


60.00' WIDE ROAD
WITH CURB, GUTTER AND SIDEWALK

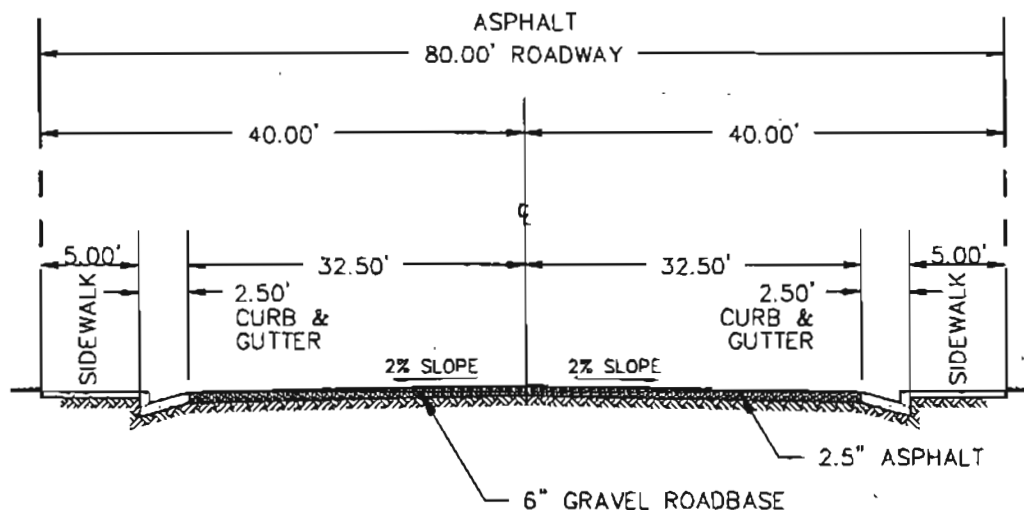
STANDARD DRAWING R-03 80.0' STREET CROSS-SECTIONS



80.00' WIDE ROAD
WITH NO ASPHALT, CURB, GUTTER
OR SIDEWALK

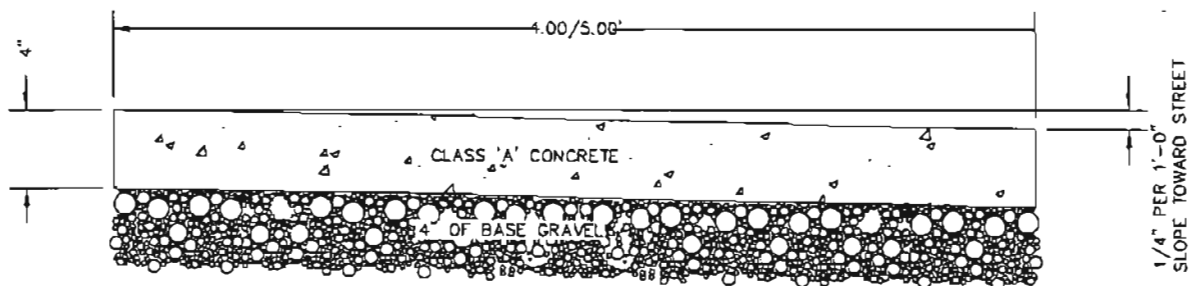


80.00' WIDE ROAD
WITH NO CURB, GUTTER OR SIDEWALK

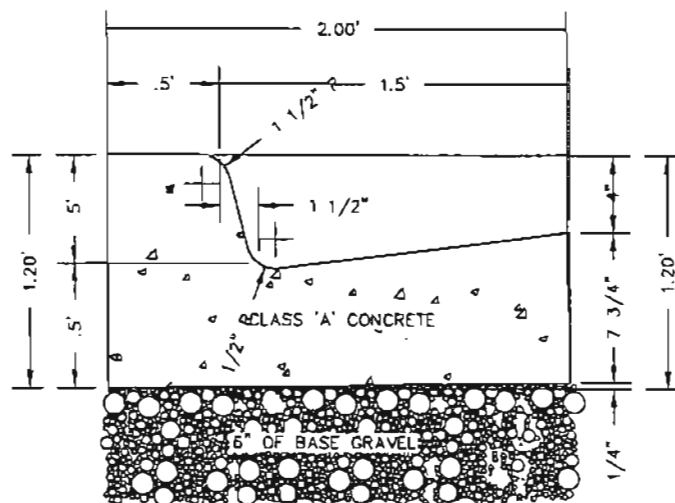


80.00' WIDE ROAD
WITH CURB, GUTTER AND SIDEWALK

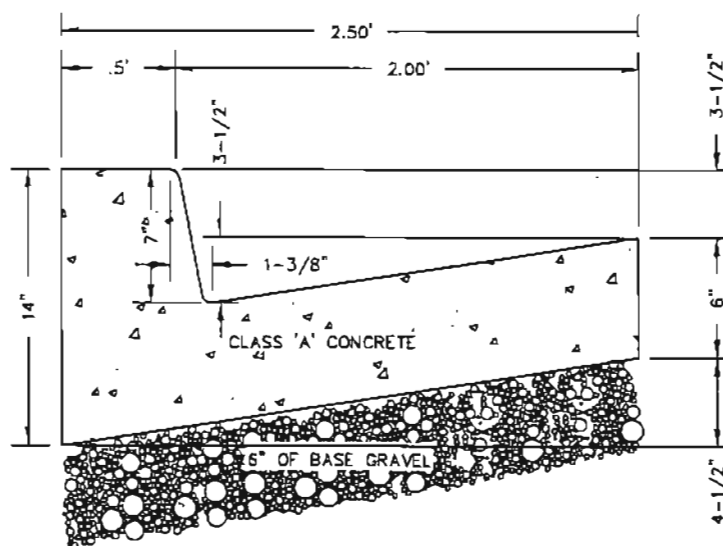
STANDARD DRAWING R-04 SIDEWALK AND CURB & GUTTER TYPICAL CROSS SECTIONS



SIDEWALK

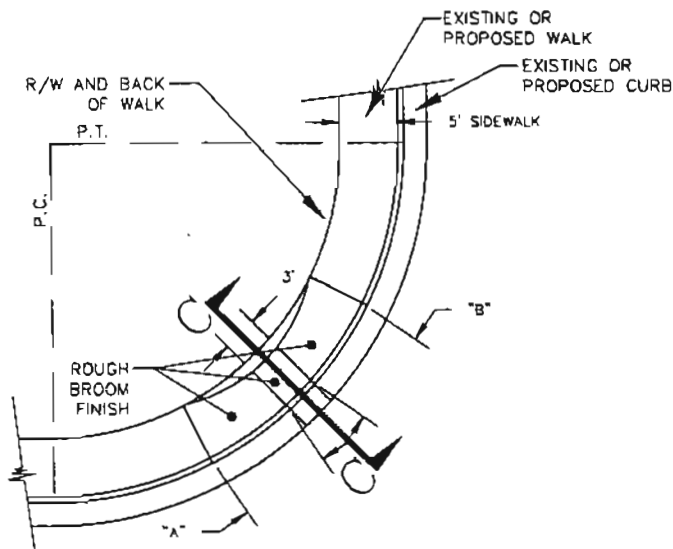


2.0' HIGHBACK CURB & GUTTER



2.5' HIGHBACK CURB & GUTTER

STANDARD DRAWING R-05 HANDICAPPED ACCESS RAMPS



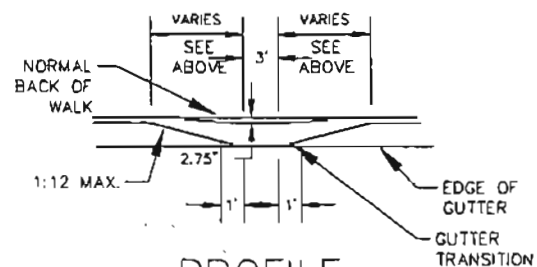
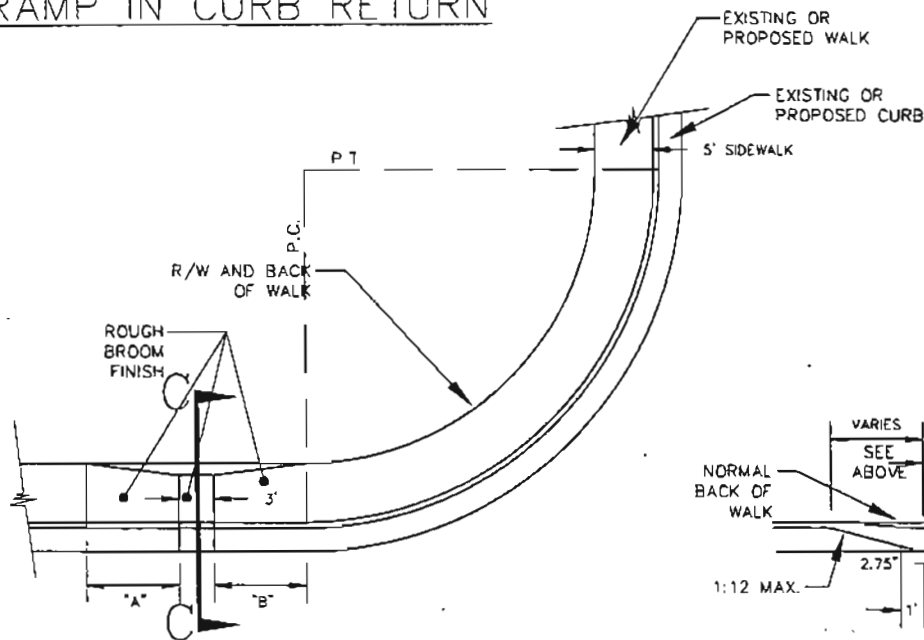
NOTES:

1. SIDEWALK RAMP WITHIN CURB RETURN SHALL BE LOCATED AT THE MIDPOINT OF CURB RETURN UNLESS OTHERWISE APPROVED.
2. SIDEWALK RAMPS OUTSIDE OF THE CURB RETURN SHALL BE LOCATED ADJACENT TO THE RETURN.
3. RAMPS SHALL BE CONSTRUCTED WITH A ROUGH BROOM FINISH TRANSVERSE TO THE SLOPE OF THE RAMP.
4. WHEN CONSTRUCTING RAMP WHERE CURB & GUTTER EXISTS, COMPLETELY REMOVE INTERFERING PORTIONS OF EXISTING CURB & GUTTER

TABLE

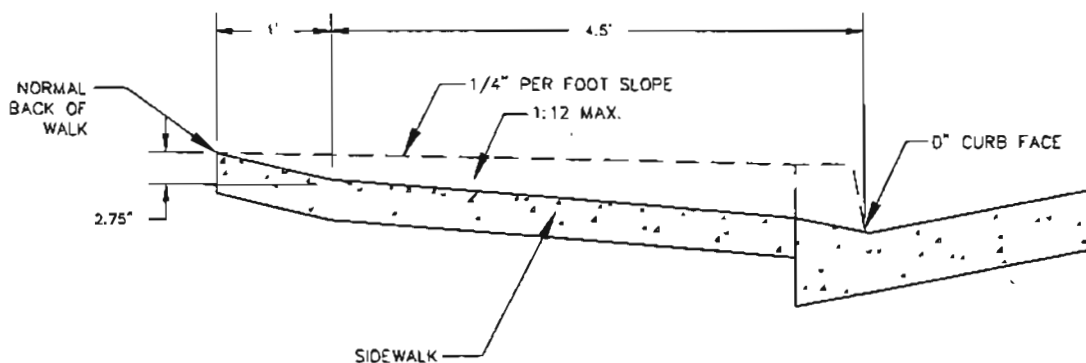
GRADE (%) B TO A	"A" (FT)	"B" (FT)
-6 TO -5.01	7.5	21.5
-5 TO -4.01	4.5	15.0
-4 TO -3.01	4.5	12.0
-3 TO -2.01	4.5	4.5
-2 TO 2	8.0	8.0
2.01 TO 3	9.5	4.5
3.01 TO 4	12.0	4.5
4.01 TO 5	15.0	4.5
5.01 TO 6	21.5	4.5

RAMP IN CURB RETURN



PROFILE

RAMP OUTSIDE CURB RETURN



SECTION C-C

MIN. WIDTH REQUIRED BY ZONE

30'

MIN. FRONTAGE REQUIRED BY ZONE

42.5' RADIUS ASPHALT

50' R

37.5' RADIUS ROADBASE IF ASPHALT NOT REQUIRED

15' R

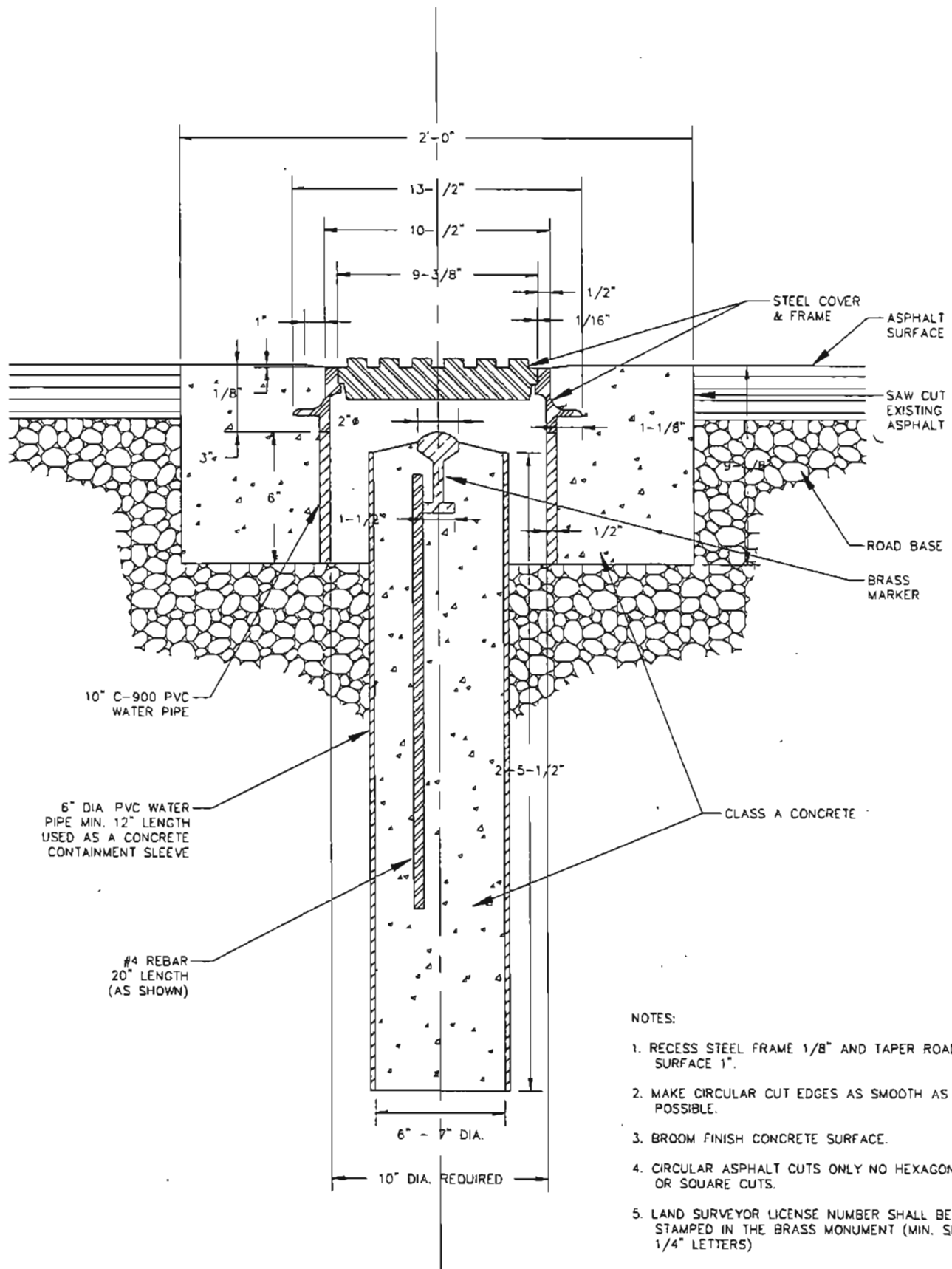
32.0' ROADBASE IF ASPHALT NOT REQUIRED

500 MAX.

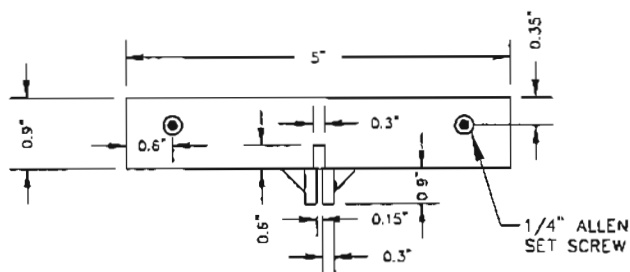
30' R

SIDEWALK, CURB & GUTTER

STANDARD DRAWING R-07 MONUMENT

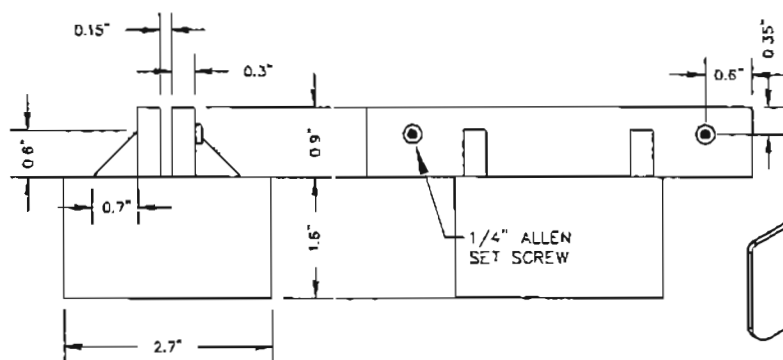


STANDARD DRAWING R-08 STREET SIGN & BRACKET DETAILS



CROSS BRACKET DETAIL

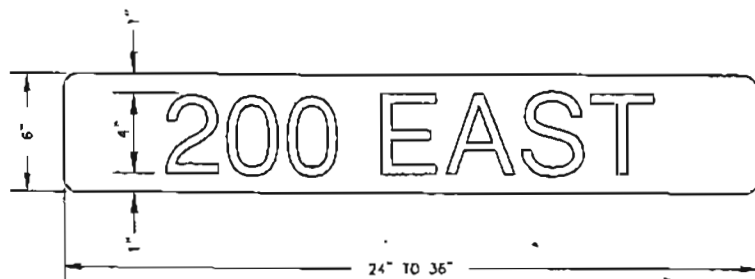
CROSS BRACKET



CAP BRACKET DETAIL

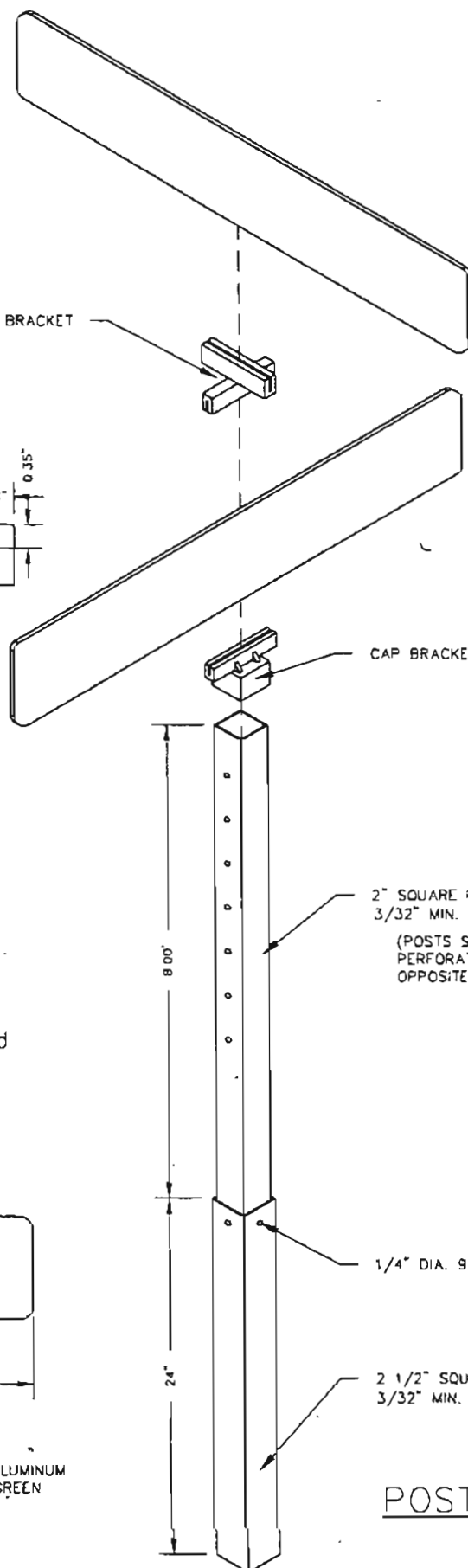
NOTES:

1. Signs shall be placed in conformance with Uniform Traffic Code requirements.
2. Street name and stop signs shall be placed behind the sidewalk and shall be required as directed by the City Engineer in all city streets.



SIGN BLANK SHALL BE 6061-T6 HEAT TREATED, HIGH TENSILE, DEGREASED ALUMINUM WITH ALAMINE 1200 FINISH. THICKNESS SHALL BE 0.080. COLOR SHALL BE GREEN WITH WHITE REFLECTIVE NUMBERS, BOTH SIDES.

STREET SIGN



CAP BRACKET

2" SQUARE POST
3/32" MIN. WALL THICKNESS
(POSTS SHALL BE
PERFORATED ON TWO
OPPOSITE SIDES)

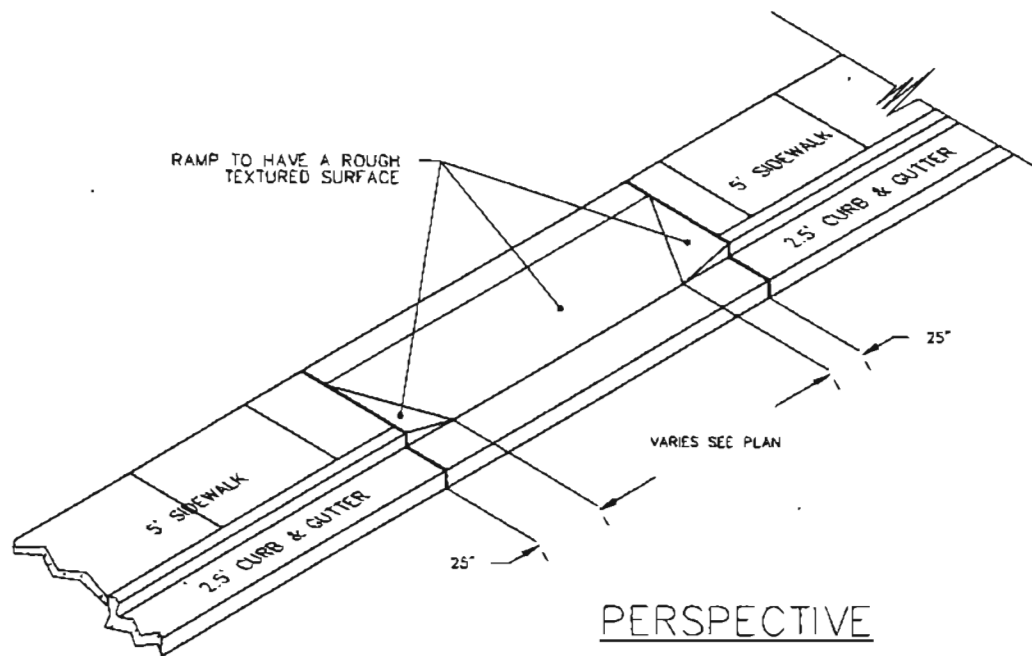
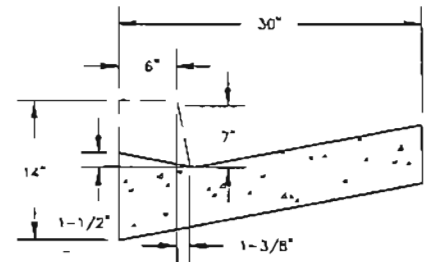
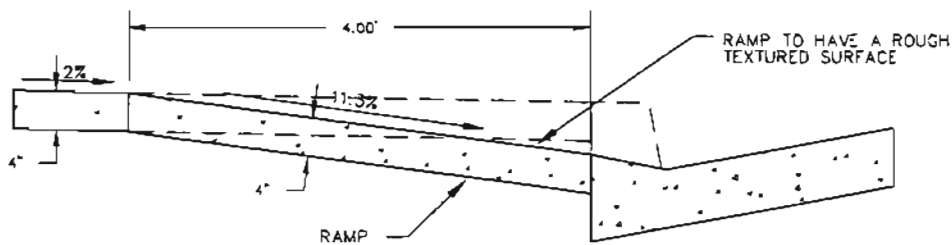
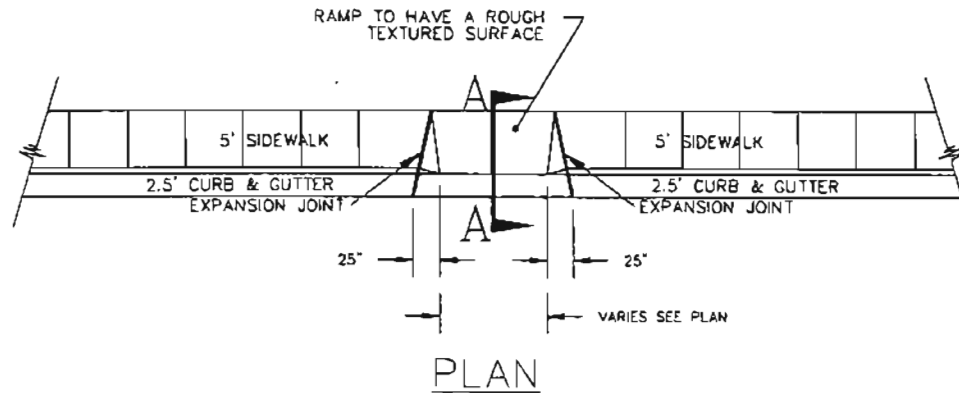
1/4" DIA. 90° BOLT

2 1/2" SQUARE ANCHOR
3/32" MIN. WALL THICKNESS

POST

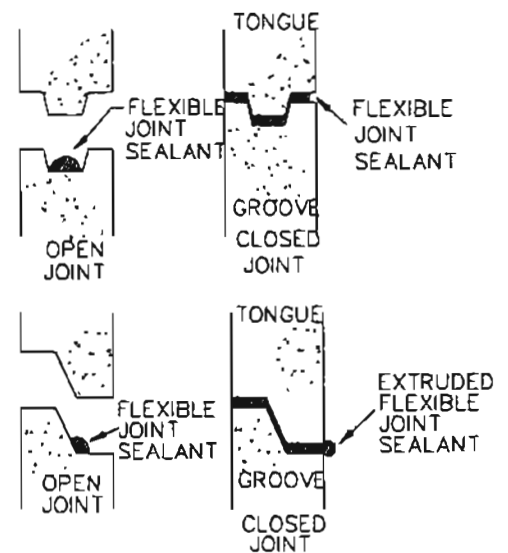
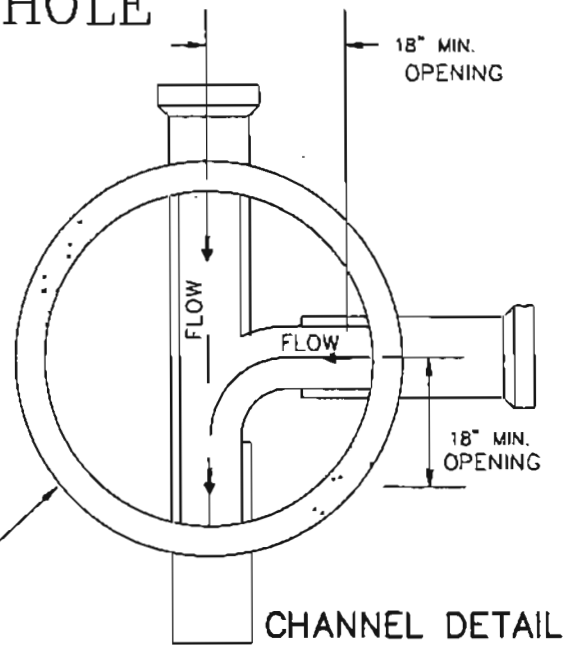
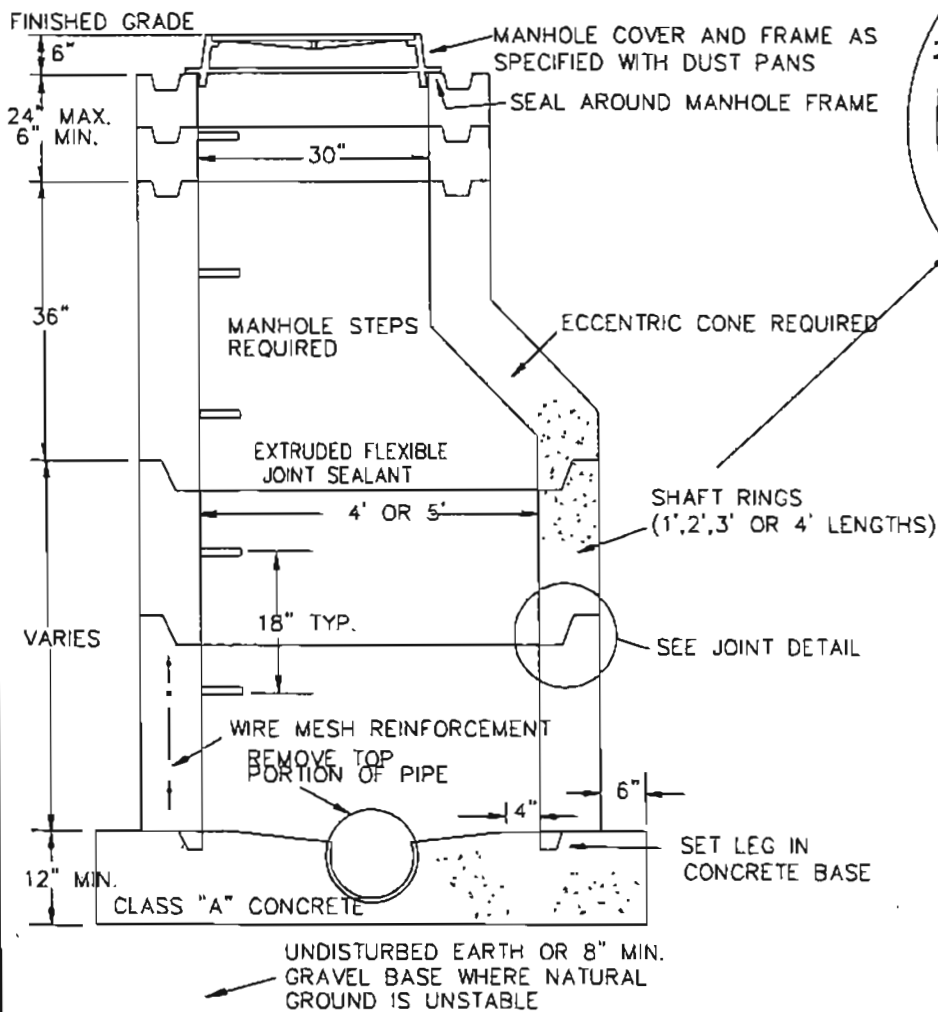
STANDARD DRAWING R-09

DRIVEWAY APPROACH

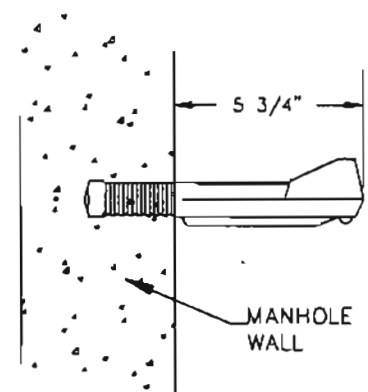
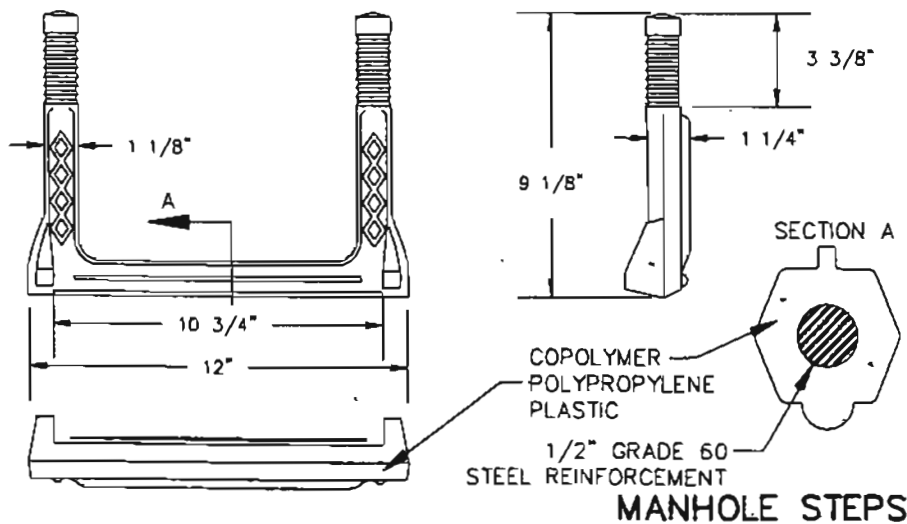


STANDARD DRAWING S-01

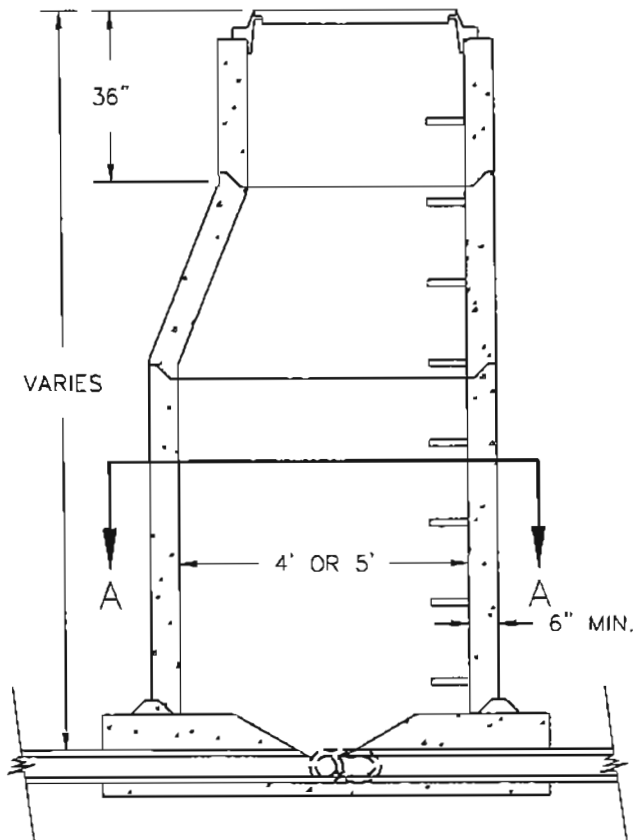
STANDARD MANHOLE



JOINT DETAILS



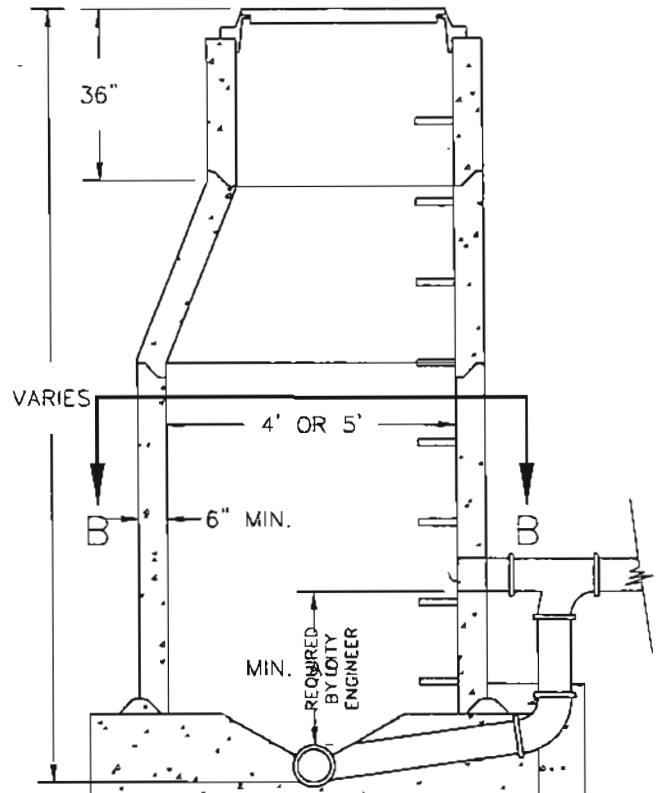
STANDARD DRAWING S-02 JUNCTION & DROP MANHOLE



TYPICAL
JUNCTION
MANHOLE

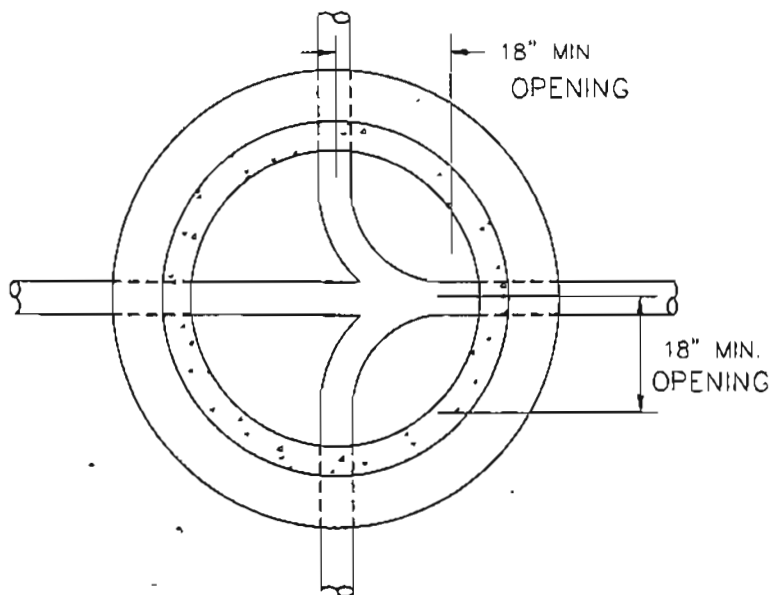
NOTES:

1. USE 4' DIA. FOR < 12" PIPE,
5' DIA. FOR > 12" PIPE AND
MORE THAN 2 PIPES IN
MANHOLES.

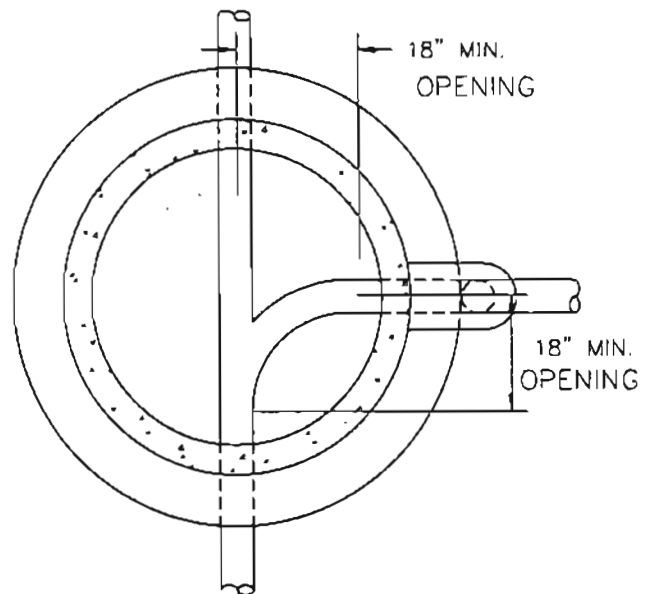


DROP PIPE
INSTALLED IN
CONCRETE

TYPICAL
DROP
MANHOLE

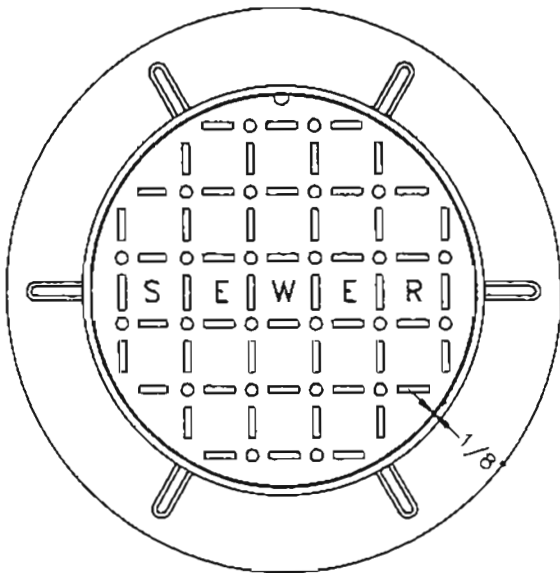


SECTION A-A

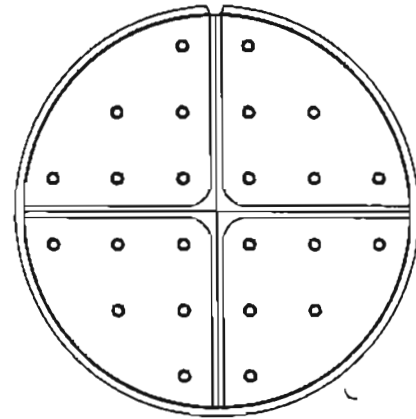


SECTION B-B

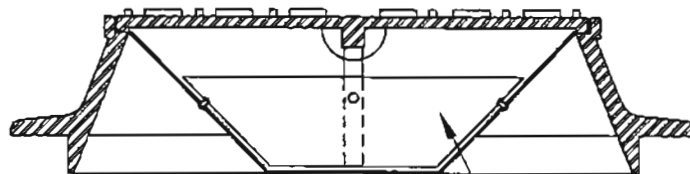
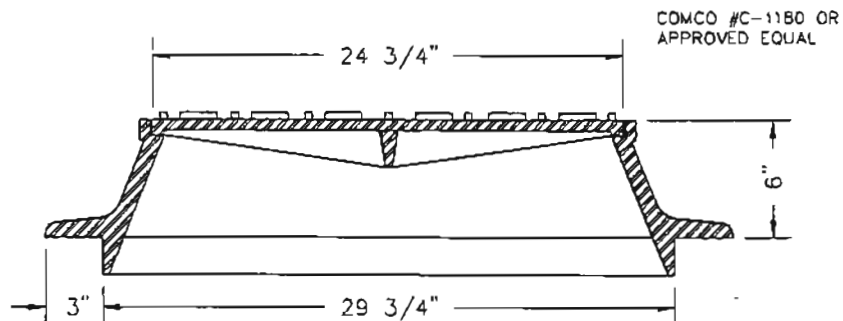
STANDARD DRAWING S-03 MANHOLE RING AND COVER



PLAN OF COVER & RING



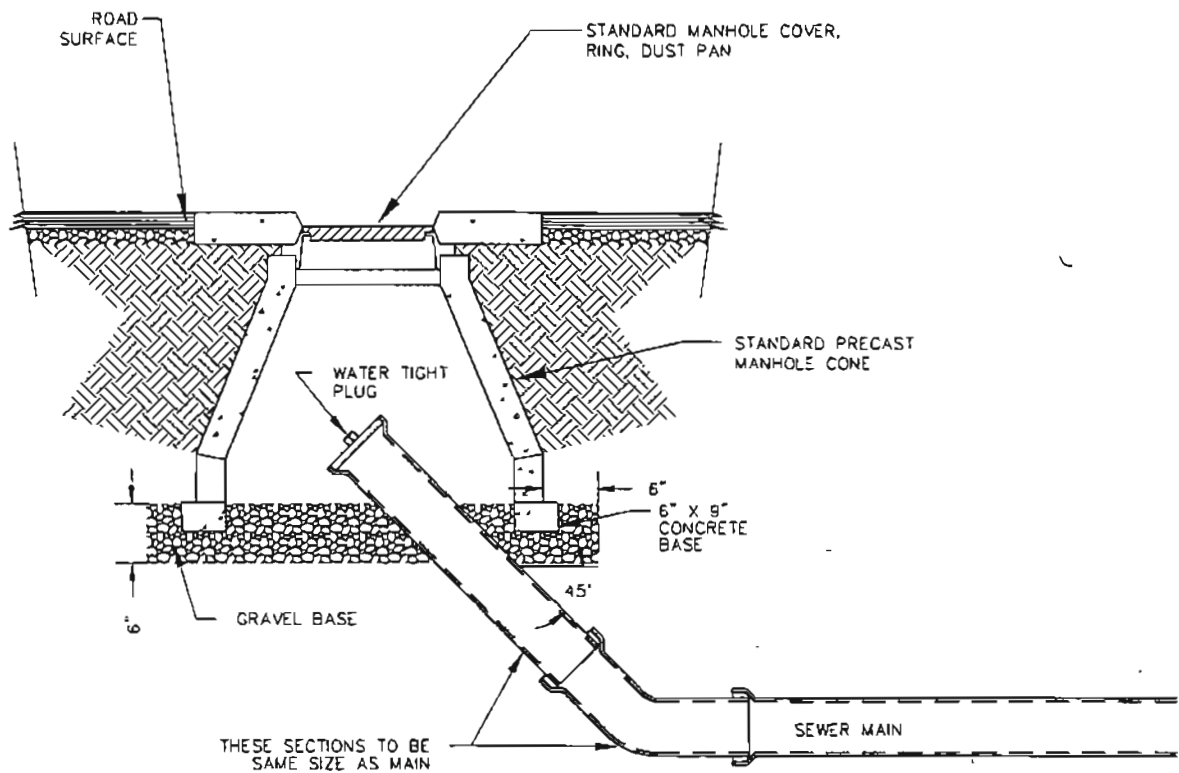
BOTTOM VIEW OF COVER



SECTIONS

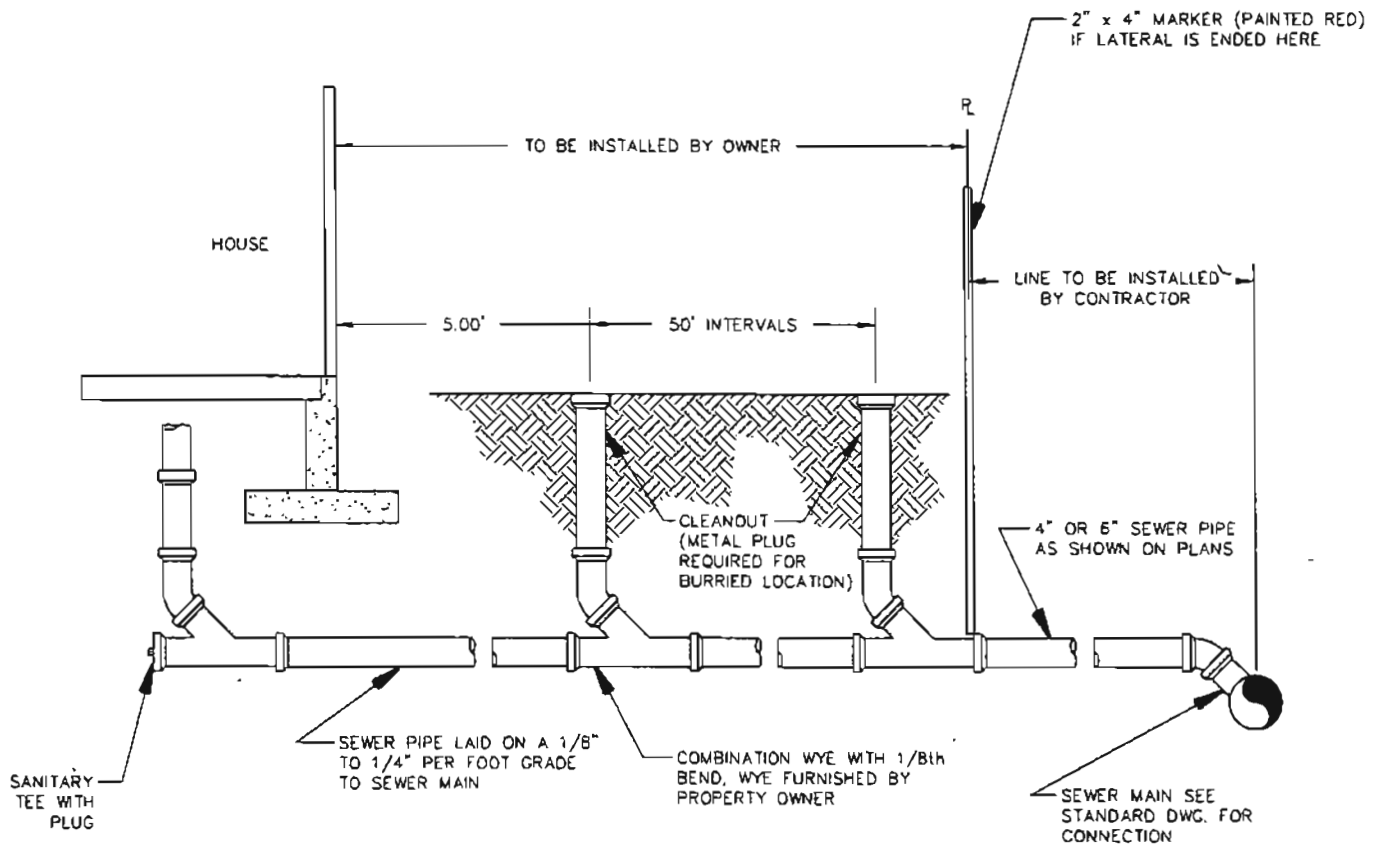
DUST PAN
ALUMINUM OR GALVANIZED
(NO FIBERGLASS)

STANDARD DRAWING S-04 SEWER MAIN CLEANOUT



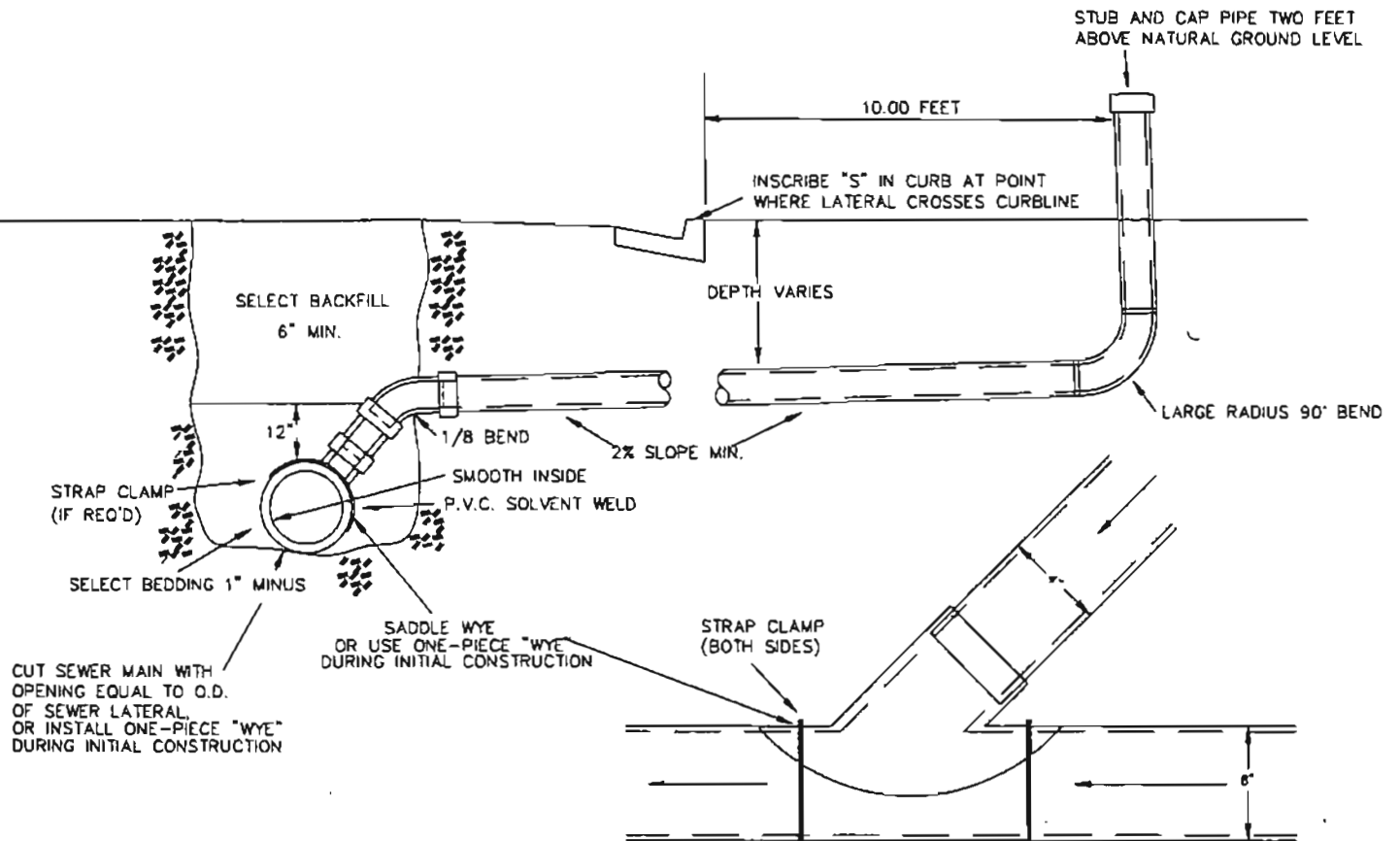
NOTE:
GRAVEL BASE TO BE 12" LARGER THAN OUTSIDE
DIAMETER OF MANHOLE CONE.

STANDARD DRAWING S-05 SEWER SERVICE CONNECTION

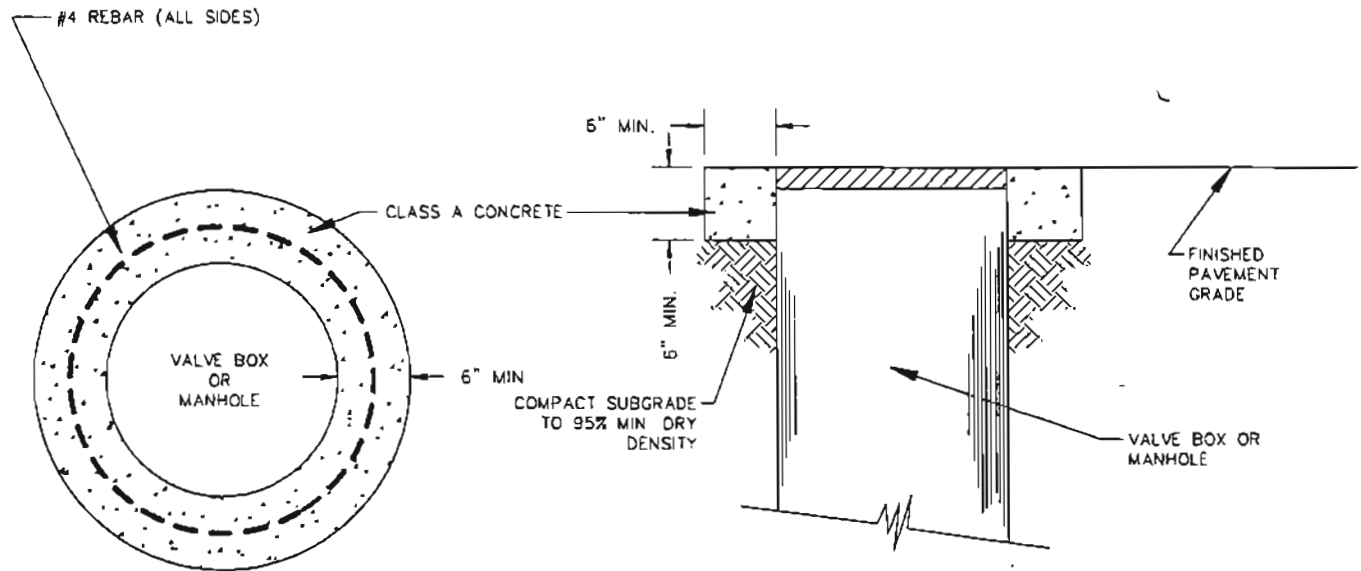


STANDARD DRAWING S-06

SERVICE CONNECTION TO SEWER MAINS



STANDARD DRAWING S-07 MANHOLE & VALVE BOX ADJUSTMENTS TO GRADE



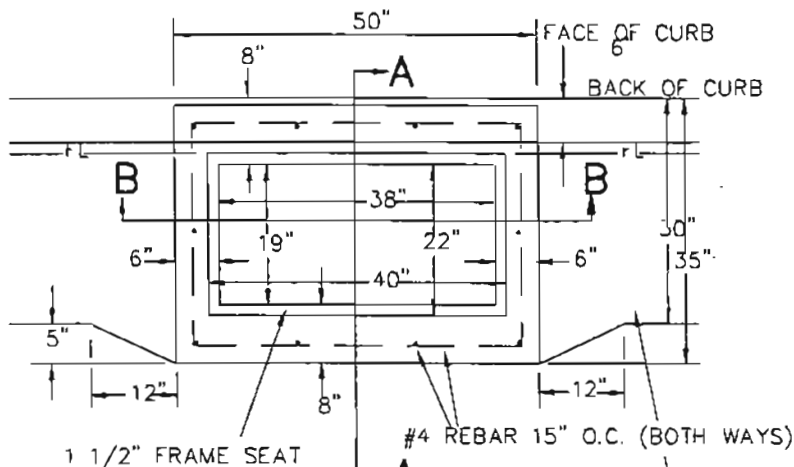
ADJUST VALVE BOXES AND MANHOLES TO GRADE AFTER PAVING IS COMPLETED. CUT OUT TOP 9" SET COVER TO GRADE AND BACKFILL WITH CONCRETE. ASPHALT SHALL BE CUT IN STRAIGHT UNIFORM LINES.

PLAN

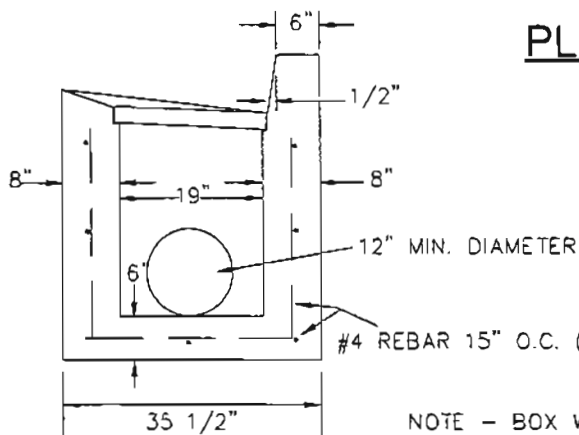
SECTION

STANDARD DRAWING SD-01

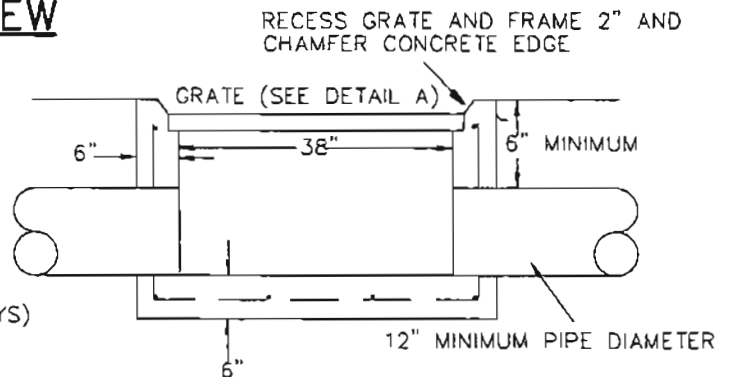
TYPE I INLET BOX



PLAN VIEW

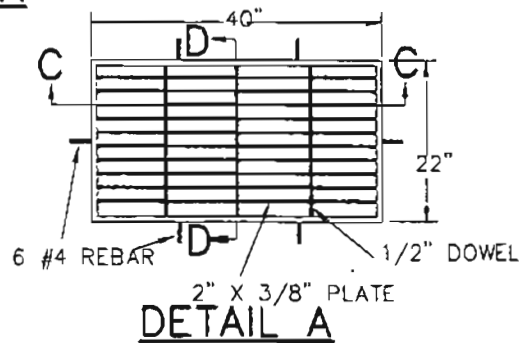


CROSS SECTION A-A

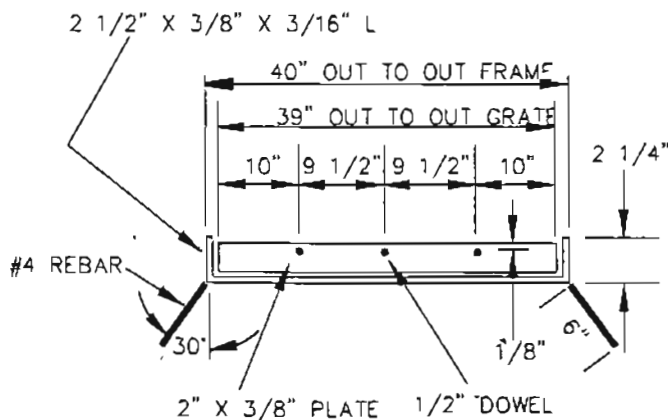


SECTION B-B

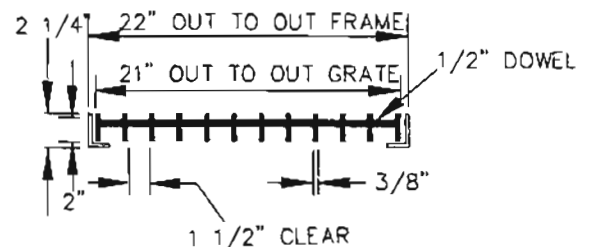
NOTE - BOX WALLS SHALL BE 6" THICK WHEN BOX IS NOT POURED AS A PART OF THE CURB. LONG DIMENSION OF BOX SHALL BE PARALLEL TO THE PIPE



DETAIL A



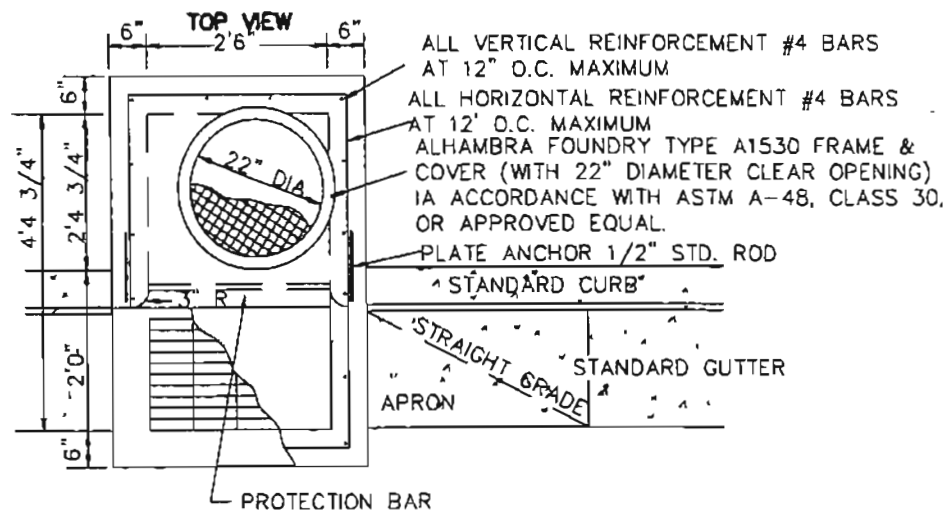
SECTION C-C



SECTION D-D

STANDARD DRAWING SD-02

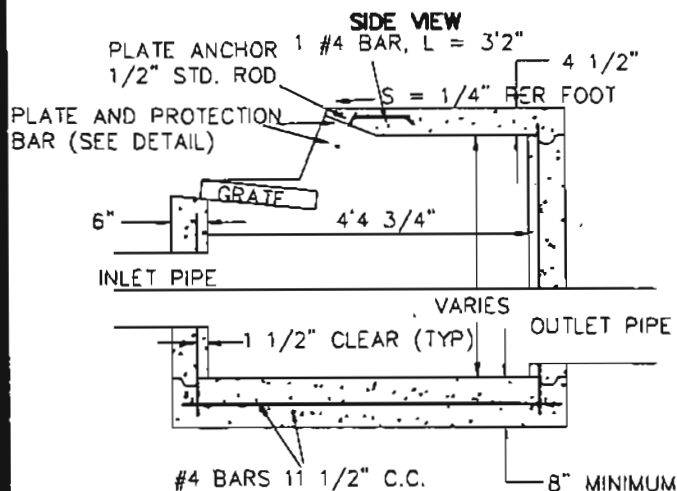
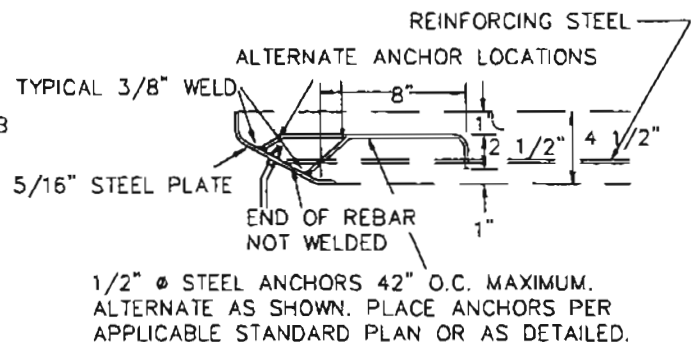
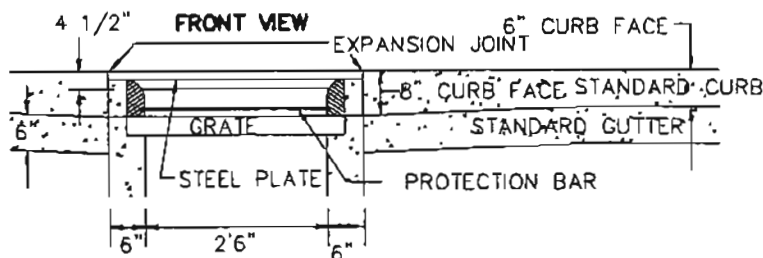
CURB INLET BOX



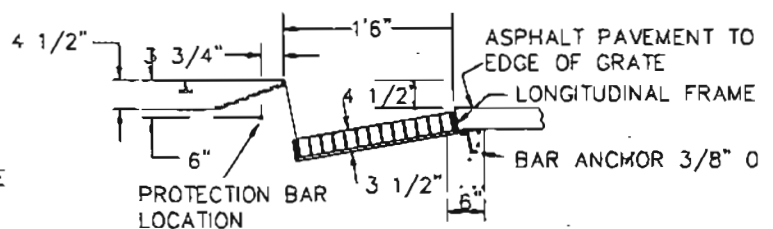
NOTES -

1. ALL EXPOSED METAL PARTS SHALL BE GALVANIZED AND ALL GALVANIZING DAMAGED BY FABRICATION OR INSTALLATION SHALL RECEIVE TWO COATS OF ALUMINUM PAINT. (GALVONOX OR EQUAL)
2. GRATE MUST BE MADE BICYCLE SAFE.
3. PIPE SIZE AND OUTLET ARE SHOWN ON ROAD PLANS.
4. DEPTH OF BOX ARE SHOWN ON ROAD PLANS.
5. CONCRETE SHALL BE TYPE V, 4000 PSI.
6. OUTLET PIPE SHALL BE TRIMMED FLUSH WITH INSIDE FACE OF INLET.

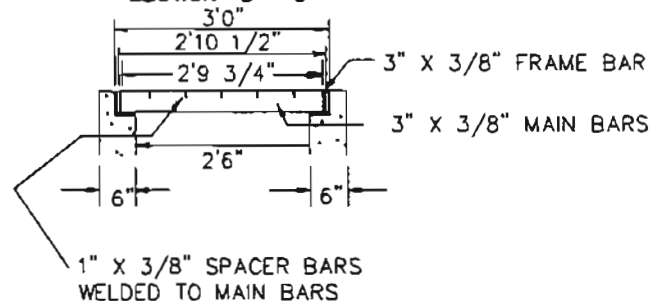
STEEL PLATE ANCHORAGE



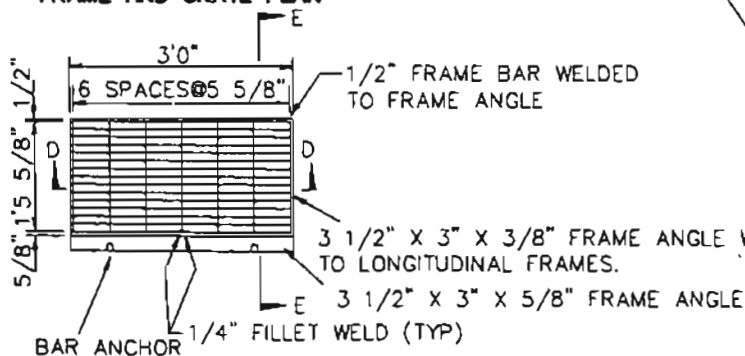
FRAME AND GRATE INSTALLATION



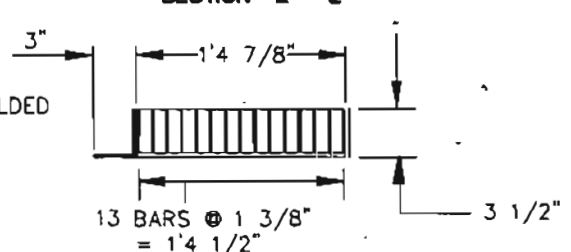
SECTION "D"- "D"



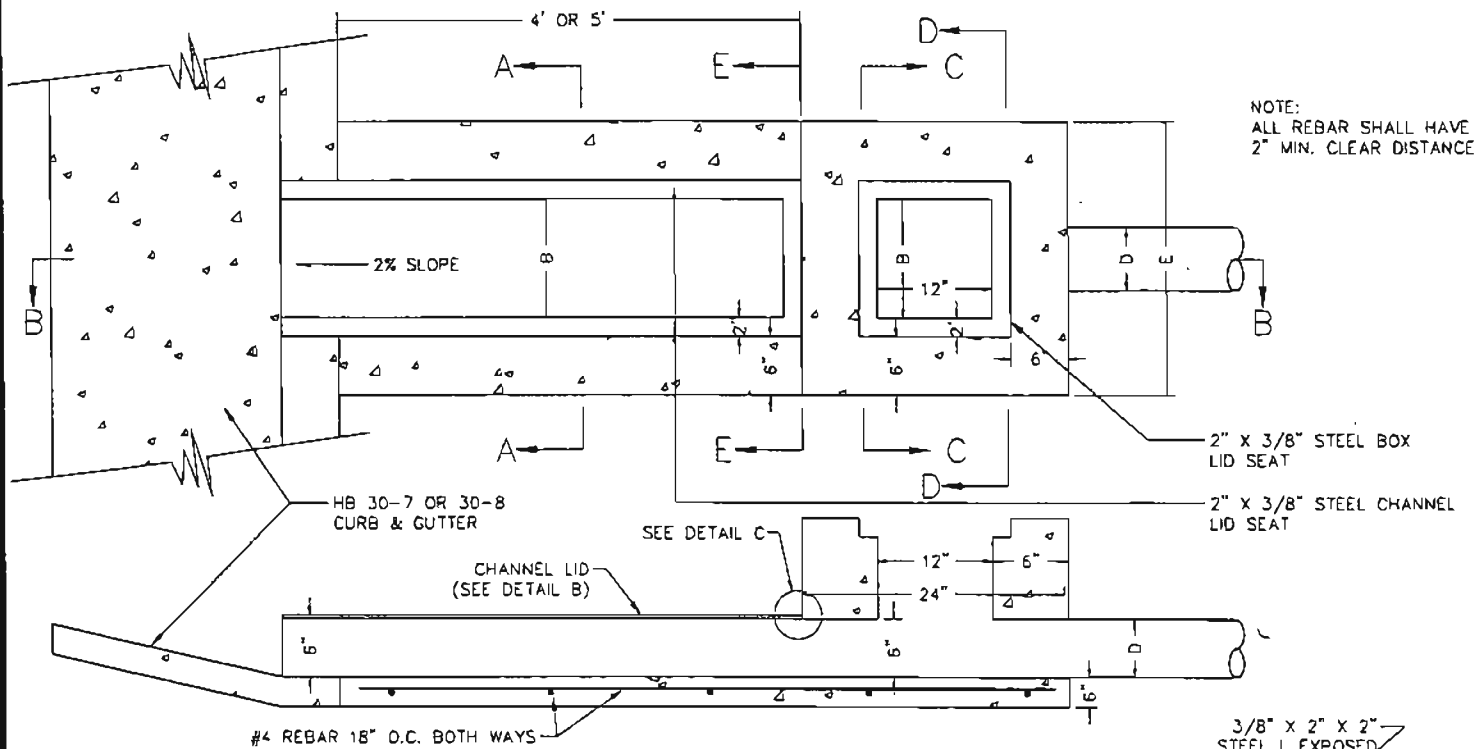
FRAME AND GRATE PLAN



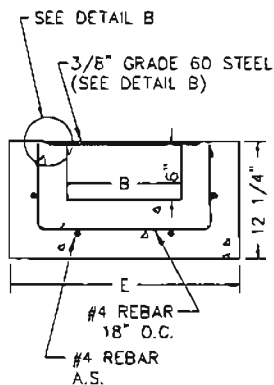
SECTION "E"- "E"



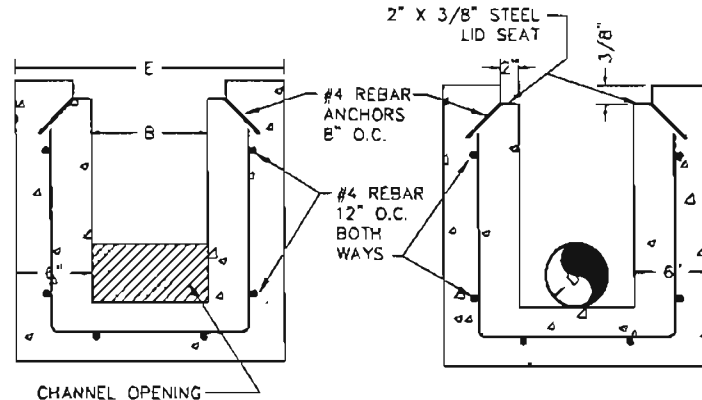
STANDARD DRAWING SD-03 SIDEWALK DRAINAGE STRUCTURE



SECTION B-B

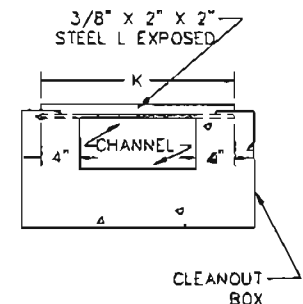


SECTION A-A

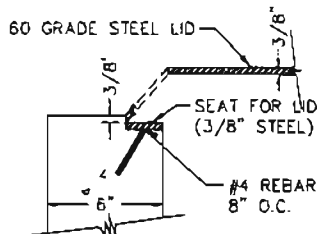


SECTION C-C

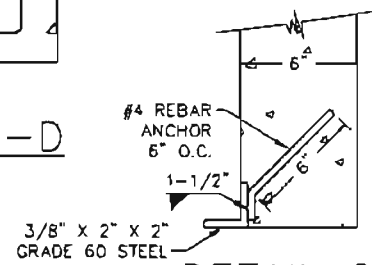
SECTION D-D



SECTION E-E



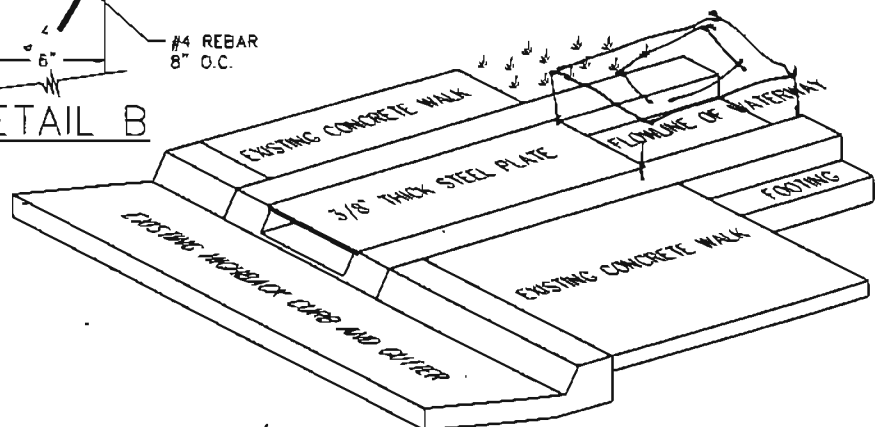
DETAIL B



DETAIL C

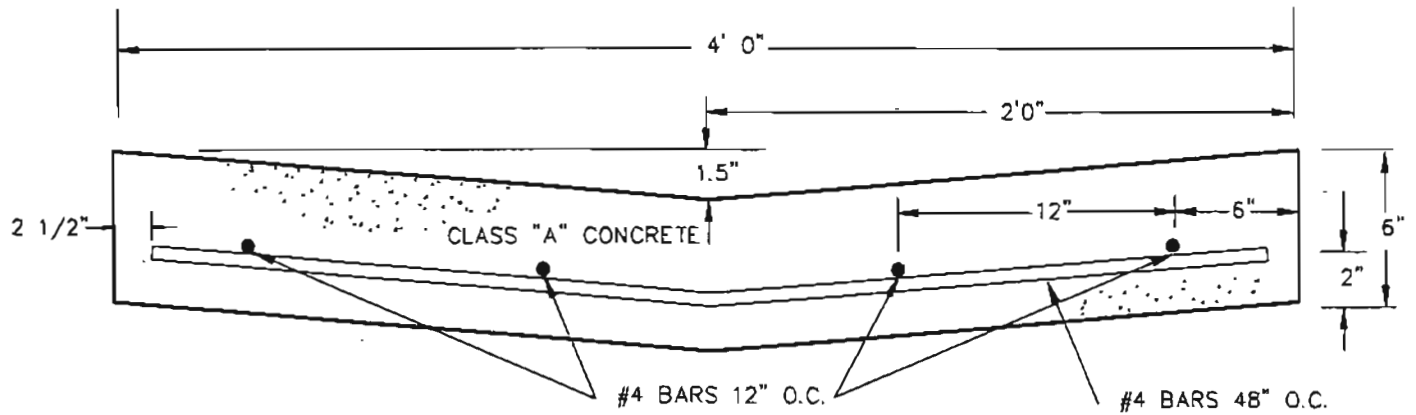
MARK	DIMENSION (INCHES)			
B	10	15	20	30
C	20	22	24	27
D	8	10	12	15
E	22	27	32	42
H	13	18	23	33
J	13 1/2	18 1/2	23 1/2	33 1/2
K	18	23	28	35
L	13 1/2	18 1/2	23 1/2	33 1/2
M	14 1/4	19 1/4	24 1/4	34 1/4

DIMENSION TABLE

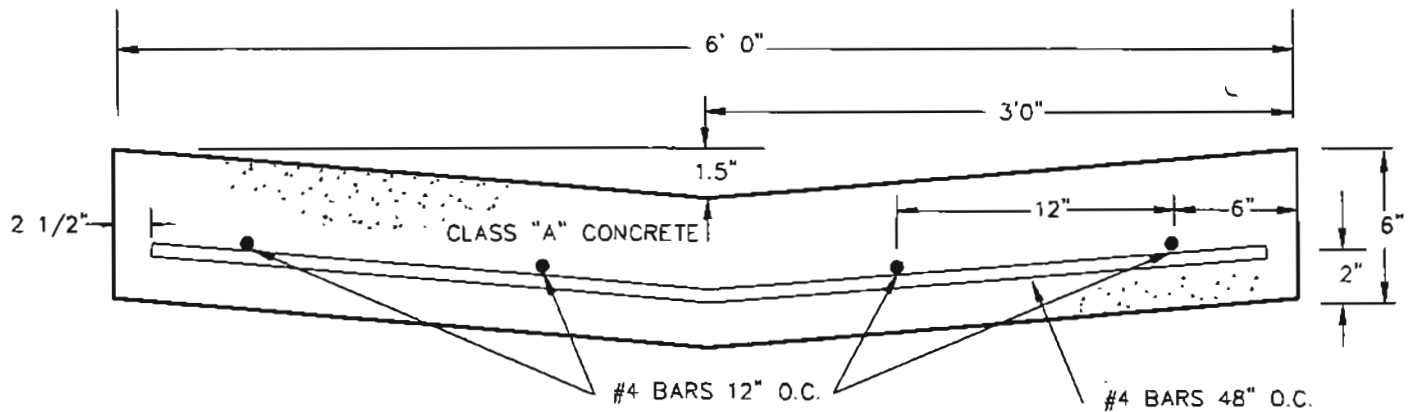


STANDARD DRAWING SD-04

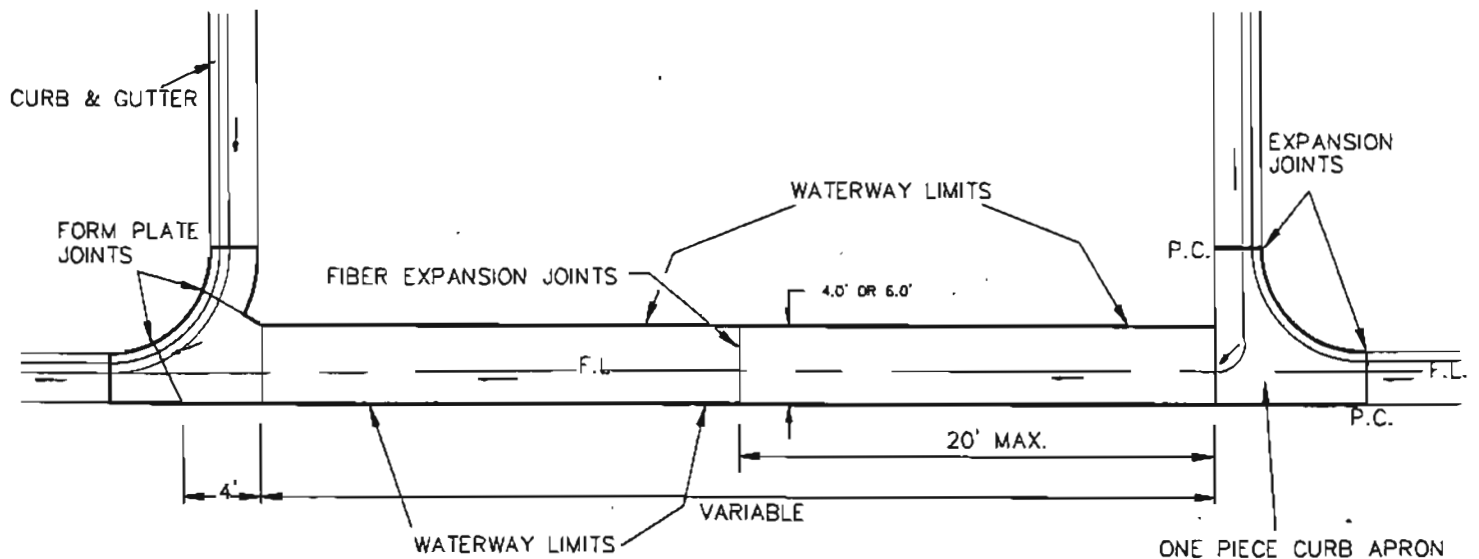
STANDARD WATERWAY



4' CROSS SECTION

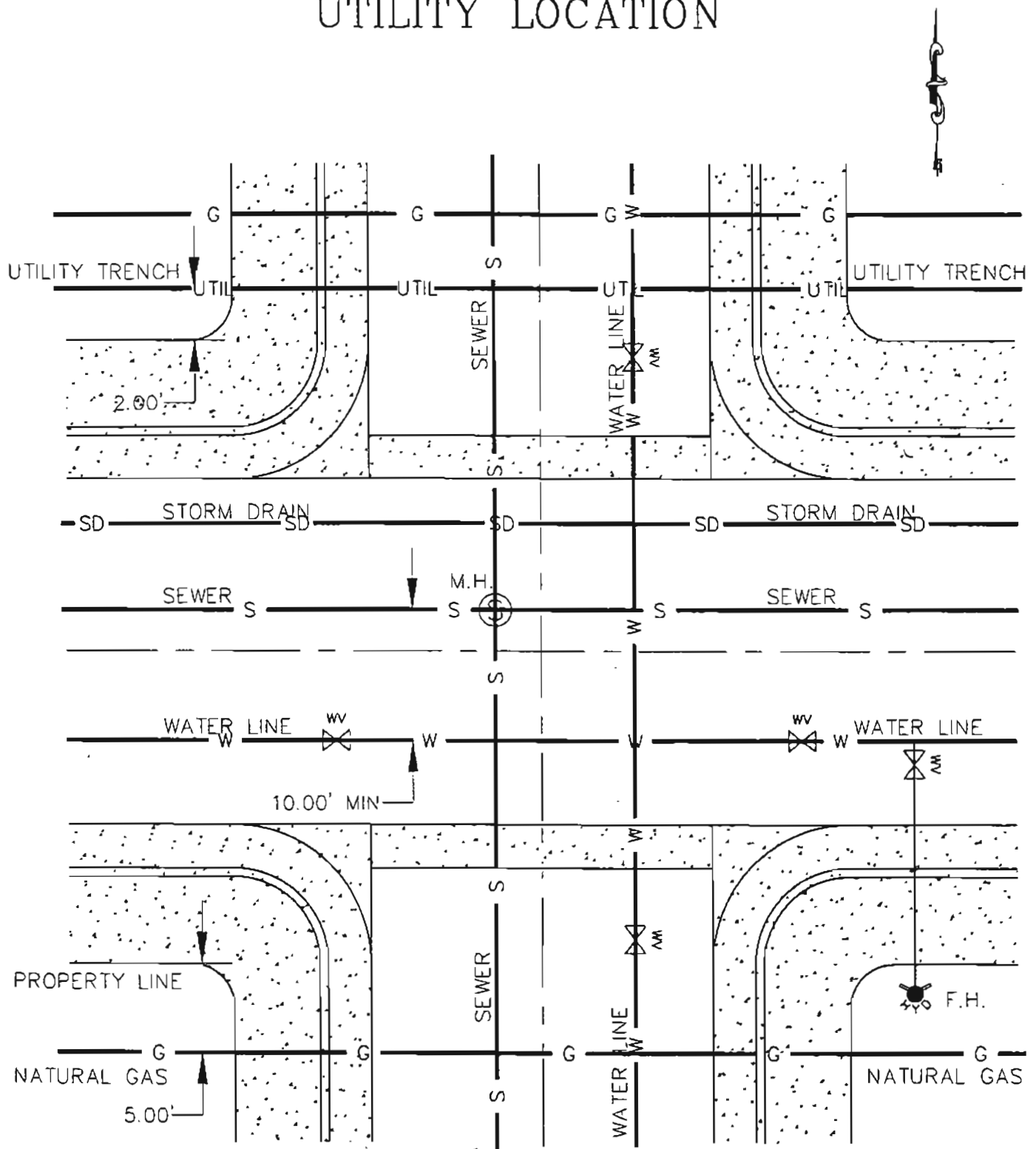


6' CROSS SECTION



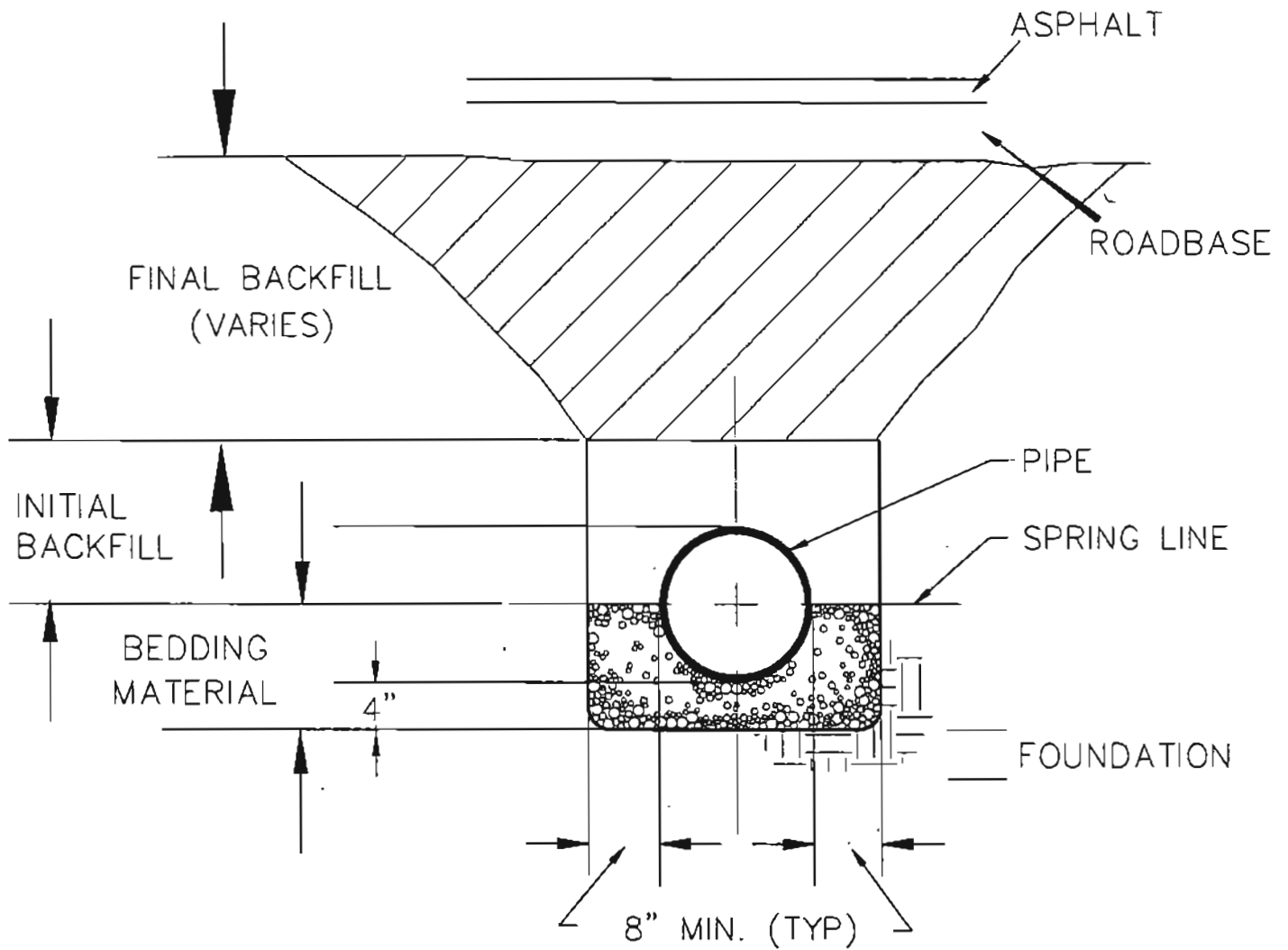
PLAN

STANDARD DRAWING U-01 STREET INTERSECTION AND UTILITY LOCATION



STANDARD DRAWING U-02

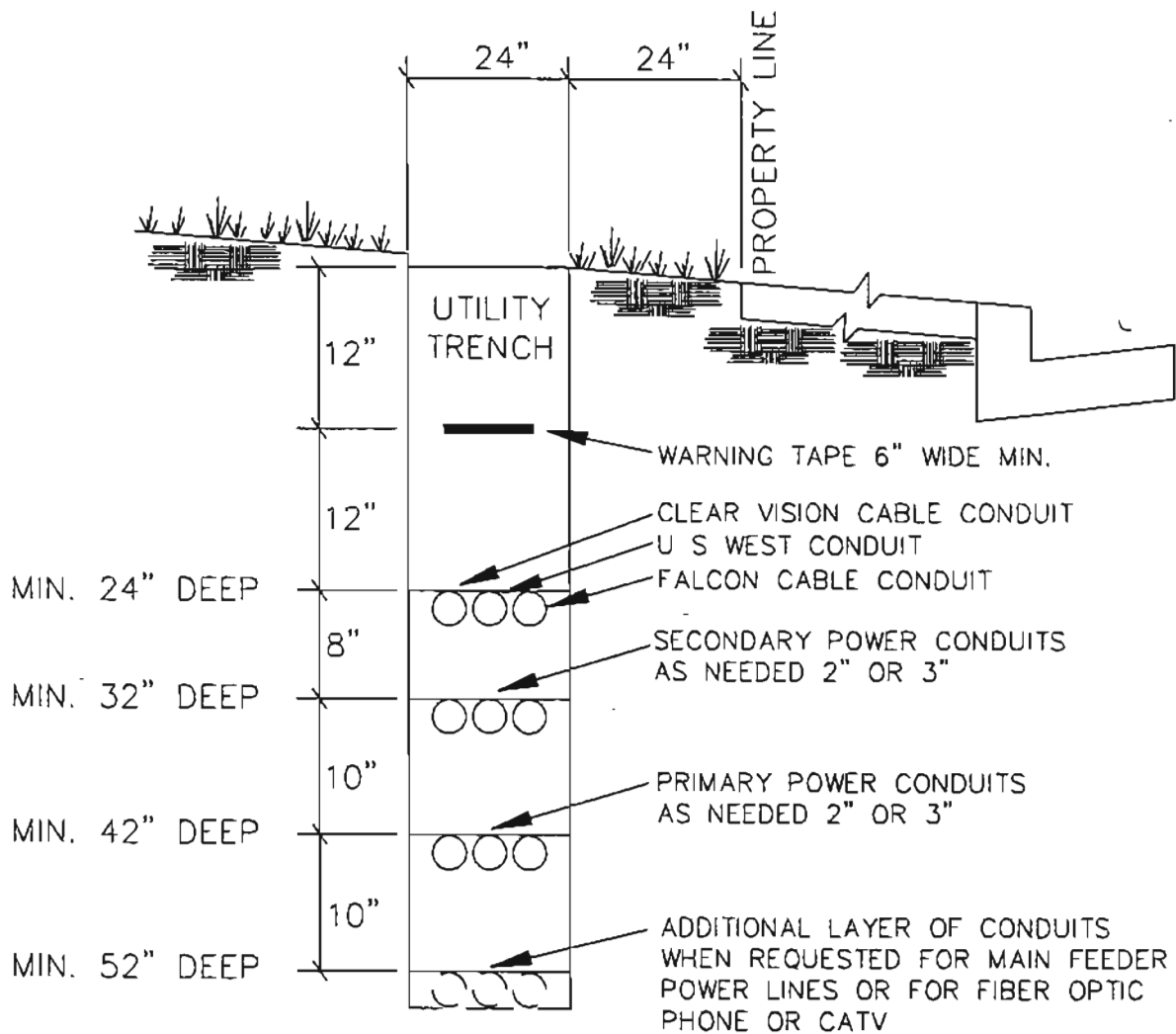
UTILITY TRENCH SECTION



NOTE: TRENCHING MUST MEET OSHA REQUIREMENTS

STANDARD DRAWING U-03

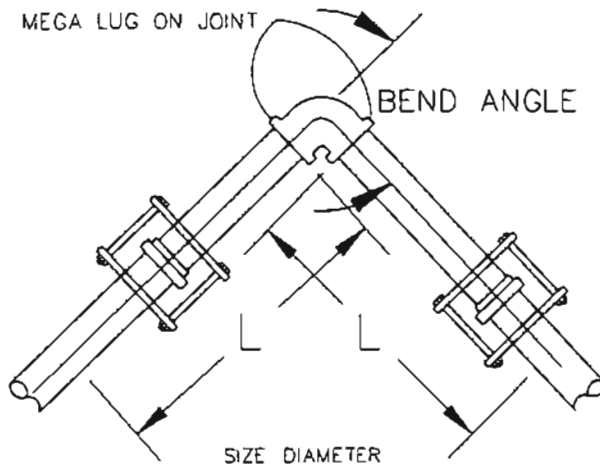
UTILITY TRENCH



STANDARD DRAWING W-02

MEGA-LUG BENDS

MEGA LUG ON JOINT

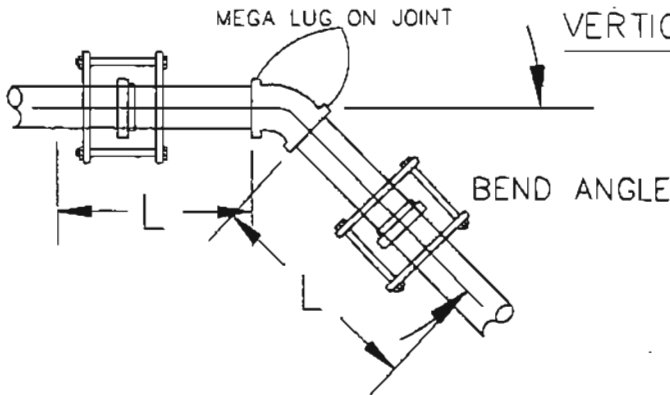


HORIZONTAL BEND

1. ALL JOINTS WITHIN LENGTH "L" MUST BE RESTRAINED. USE RETAINER GLAND AT MECHANICAL JOINTS AND HARNESS WITH PUSH-ON PIPE PER CITY SPECIFICATION.
2. FOR TEST PRESSURES AND LAYING CONDITIONS SEE SECTION ON GENERAL NOTES FOR USE OF RESTRAINED JOINT LENGTHS.

BEND ANGLE	SIZE DIAMETER								
	4	6	8	10	12	14	16	18	20
	11.25	2	3	4	4	5	6	7	8
	22.5	4	6	7	9	10	12	13	15
	45	8	12	15	18	21	24	28	33
	90	20	28	37	44	52	59	67	81

RESTRAINED LENGTHS, "L" (IN FEET)



VERTICAL DOWN BEND

1. ALL JOINTS WITHIN LENGTH "L" MUST BE RESTRAINED. USE RETAINER GLAND AT MECHANICAL JOINTS AND HARNESS WITH PUSH-ON PIPE PER CITY SPECIFICATION.
2. FOR TEST PRESSURES AND LAYING CONDITIONS SEE SECTION ON GENERAL NOTES FOR USE OF RESTRAINED JOINT LENGTHS.

BEND ANGLE	SIZE DIAMETER								
	4	6	8	10	12	14	16	18	20
	11.25	6	8	10	12	14	15	17	20
	22.5	11	15	19	23	27	31	35	40
	45	23	31	40	48	56	64	72	80

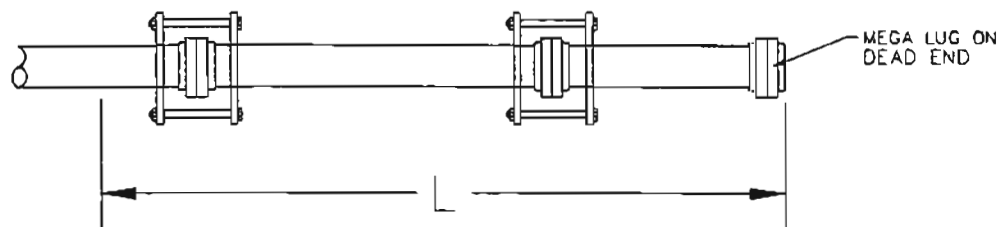
RESTRAINED LENGTHS, "L" (IN FEET)

STANDARD BENDS FOR PVG

STANDARD DRAWING W-03

MEGA-LUG VALVE

IN LINE VALVE/DEAD END ON PVC PIPE



1. ALL JOINTS WITHIN LENGTH "L" MUST BE RESTRAINED. USE RETAINER GLAND AT MECHANICAL JOINTS AND HARNESS WITH PUSH-ON PIPE PER CITY SPECIFICATION.
2. FOR TEST PRESSURES AND LAYING CONDITIONS SEE SECTION ON GENERAL NOTES FOR USE OF RESTRAINED JOINT LENGTHS.

PIPE SIZE IN INCHES

4	6	8	10	12	14	16	18	20
44	62	82	99	118	135	153	169	187

RESTRAINED LENGTHS, "L" (IN FEET)

RESTRAINED JOINT LENGTHS USAGE GENERAL NOTES

RESTRAINED LENGTH CALCULATIONS ARE BASED ON THE FOLLOWING DESIGN TYPICALLY USED WITH BACKFILL IN FRESNO.

1. THREE (3) FEET MINIMUM DEPTH OF COVER.
2. A SAFETY FACTOR OF 1.5
3. SOIL TYPE SANDY CLAY
4. TYPE 5 TRENCH COMPACTION FROM FOUR (4) INCHES MINIMUM UNDER THE PIPE TO THE CENTER LINE OF THE PIPE, AND COMPACTED GRANULAR OR SELECTED MATERIAL FROM THE CENTER LINE OF THE PIPE TO THE TOP OF THE PIPE (90 PERCENT STANDARD PROCTOR DENSITY, AASHTO T-99).
5. 200 PSI TEST PRESSURES FOR FOUR (4) THROUGH SIXTEEN (16) INCH SIZE PIPES.

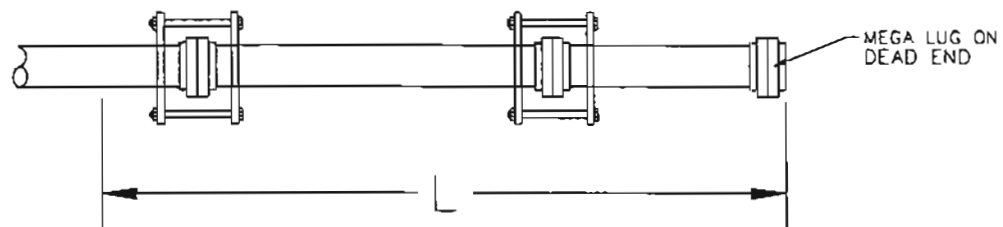
IF ACTUAL CONDITIONS DIFFER FROM THOSE LISTED ABOVE OR THE REQUIRED RESTRAINED LENGTH CANNOT BE MET, THE RESTRAINED JOINT LENGTH SHALL BE DETERMINED BY THE WATER AND POWER ENGINEER.

IN LINE VALVE/DEAD END ON PVC PIPE

STANDARD DRAWING W-03

MEGA-LUG VALVE

IN LINE VALVE/DEAD END ON PVC PIPE



1. ALL JOINTS WITHIN LENGTH "L" MUST BE RESTRAINED. USE RETAINER GLAND AT MECHANICAL JOINTS AND HARNESS WITH PUSH-ON PIPE PER CITY SPECIFICATION.
2. FOR TEST PRESSURES AND LAYING CONDITIONS SEE SECTION ON GENERAL NOTES FOR USE OF RESTRAINED JOINT LENGTHS.

PIPE SIZE IN INCHES

4	6	8	10	12	14	16	18	20
44	62	82	99	118	135	153	169	187

RESTRAINED LENGTHS, "L" (IN FEET)

RESTRAINED JOINT LENGTHS USAGE GENERAL NOTES

RESTRAINED LENGTH CALCULATIONS ARE BASED ON THE FOLLOWING DESIGN TYPICALLY USED WITH BACKFILL IN FRESNO.

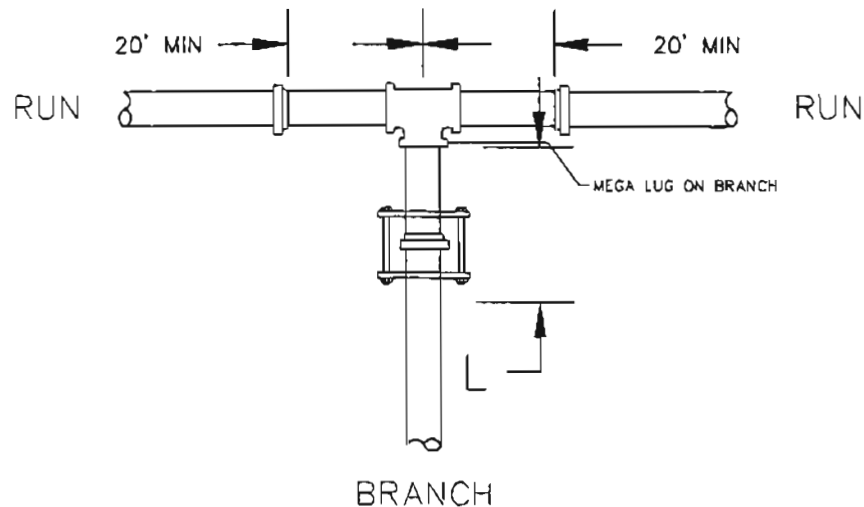
1. THREE (3) FEET MINIMUM DEPTH OF COVER.
2. A SAFETY FACTOR OF 1.5
3. SOIL TYPE SANDY CLAY
4. TYPE 5 TRENCH COMPACTION FROM FOUR (4) INCHES MINIMUM UNDER THE PIPE TO THE CENTER LINE OF THE PIPE, AND COMPACTED GRANULAR OR SELECTED MATERIAL FROM THE CENTER LINE OF THE PIPE TO THE TOP OF THE PIPE (90 PERCENT STANDARD PROCTOR DENSITY, AASHTO T-99).
5. 200 PSI TEST PRESSURES FOR FOUR (4) THROUGH SIXTEEN (16) INCH SIZE PIPES.

IF ACTUAL CONDITIONS DIFFER FROM THOSE LISTED ABOVE OR THE REQUIRED RESTRAINED LENGTH CANNOT BE MET, THE RESTRAINED JOINT LENGTH SHALL BE DETERMINED BY THE WATER AND POWER ENGINEER.

IN LINE VALVE/DEAD END ON PVC PIPE

STANDARD DRAWING W-04

MEGA-LUG TEE



RUN SIZE DIAMETER		4	6	8	10	12	14	16	18	20	24
BRANCH SIZE DIAMETER	4	*	*	*	*	*	*	*	*	*	*
	6	X	*	*	*	*	*	*	*	*	*
	8	X	X	*	*	*	*	*	*	*	*
	10	X	X	X	10	*	*	*	*	*	*
	12	X	X	X	X	28	12	4	*	*	*
	14	X	X	X	X	X	45	31	17	3	*
	16	X	X	X	X	X	X	62	49	37	11
	18	X	X	X	X	X	X	X	78	67	44
	20	X	X	X	X	X	X	X	X	95	74
	24	X	X	X	X	X	X	X	X	X	127

* - FOR THIS CONDITION NEED ONLY RESTRAIN THE BRANCH OUTLET OF THE TEE.

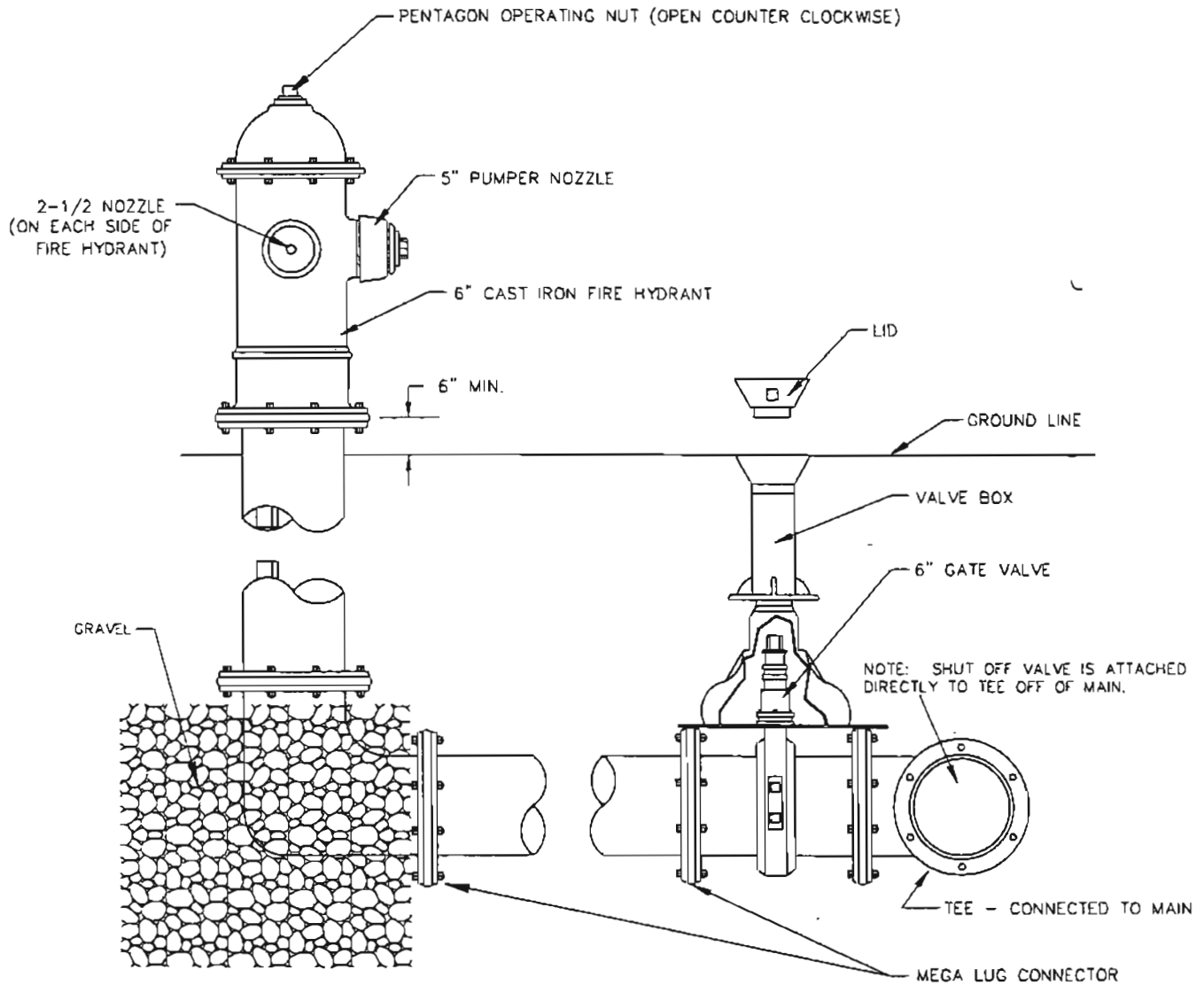
RESTRAINED LENGTHS, "L" (IN FEET)

1. RESTRAIN THE TWO MECHANICAL JOINTS ON THE RUN SIDES OF THE TEE. THERE SHOULD BE A FULL 20' LENGTH OF PIPE INSTALLED ON EACH SIDE OF THE RUN.
2. ALL JOINTS WITHIN THE LENGTH "L" ON THE BRANCH MUST BE RESTRAINED. USE RETAINER GLAND AT MECHANICAL JOINTS AND HARNESS ON PUSH-ON PIPE PER CITY SPECIFICATION.
3. FOR TEST PRESSURES AND LAYING CONDITIONS SEE SECTION ON GENERAL NOTES FOR USE OF RESTRAINED JOINT LENGTHS.

STANDARD TEE PVC

STANDARD DRAWING W-05

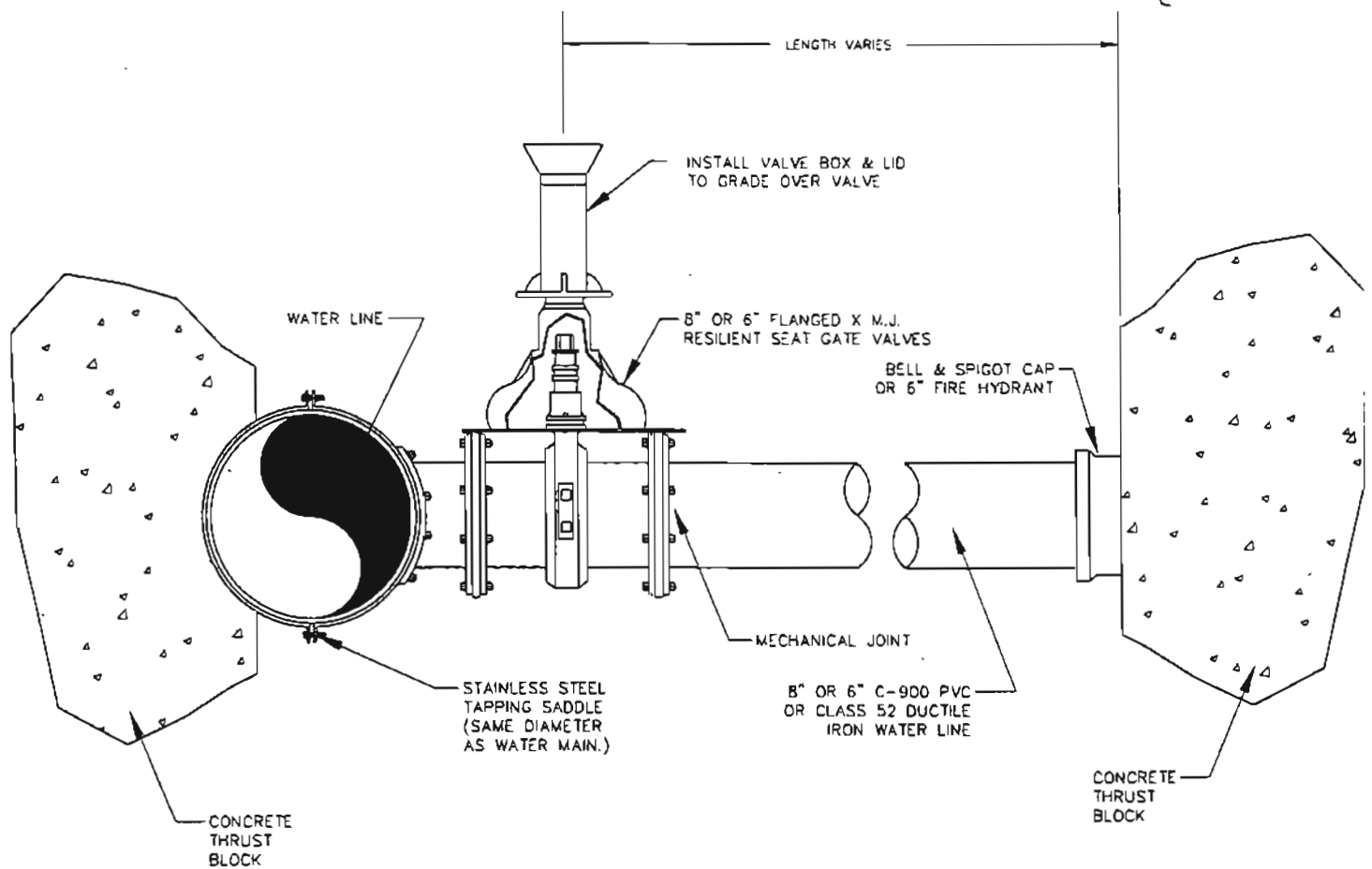
STANDARD FIRE HYDRANT



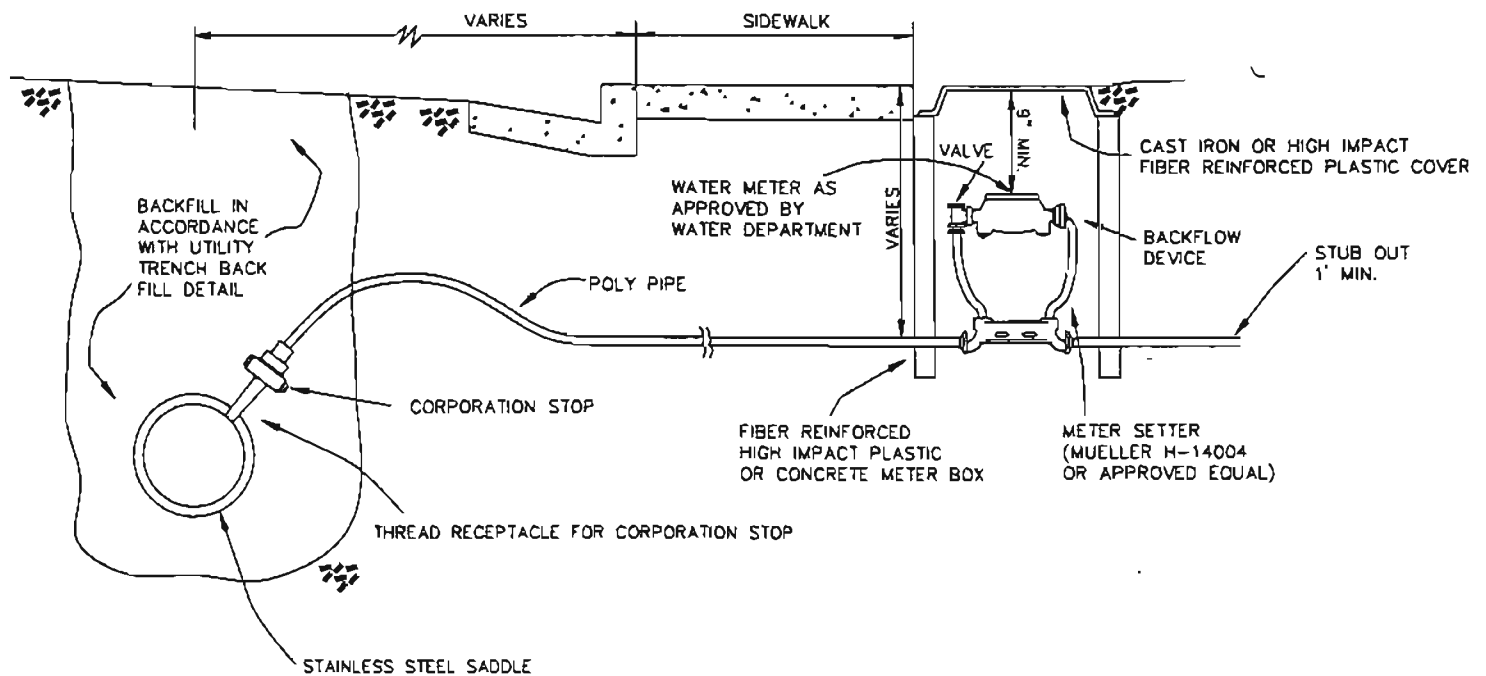
STANDARD DRAWING W-06

8" OR 6" WATER LATERAL

(CONNECTION TO EXISTING MAIN)



STANDARD DRAWING W-07 WATER SERVICE CONNECTION AND METER



STANDARD DRAWING W-08

VALVE DETAIL

